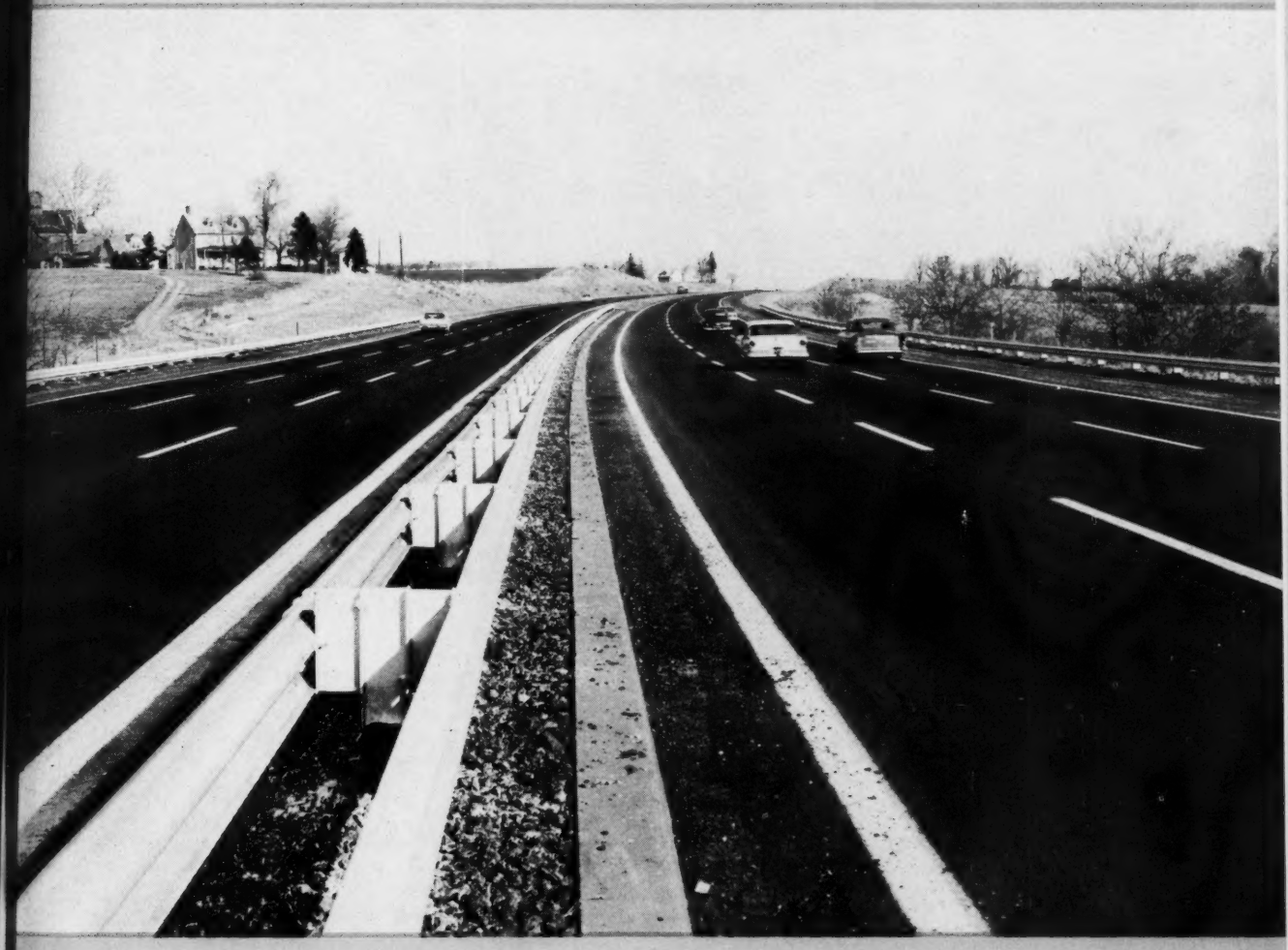
OCTOBER, 1960
Printed in Two Parts
Part I

TRAFFIC ENGINEERING



- Designing Better Freeways
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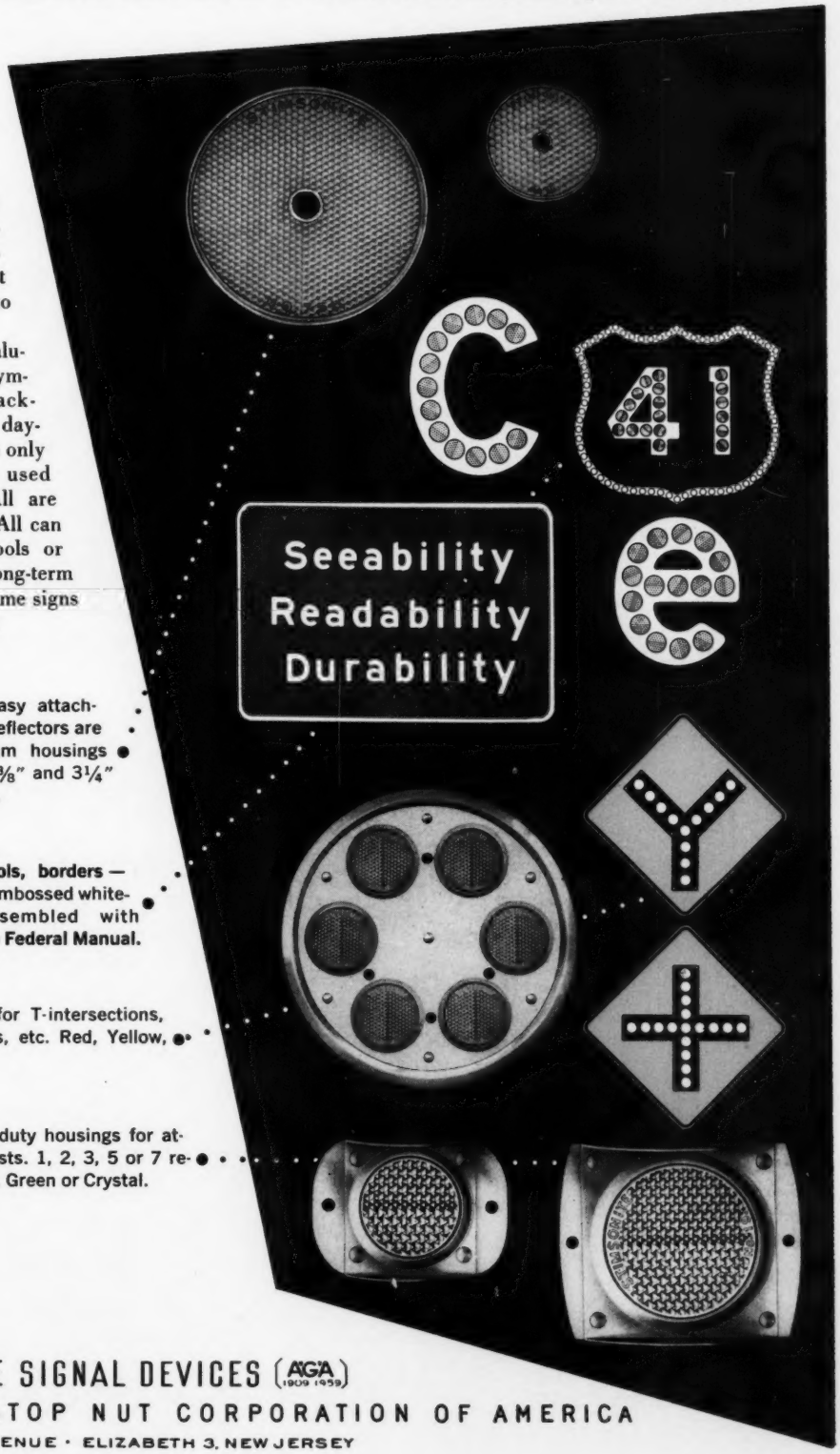

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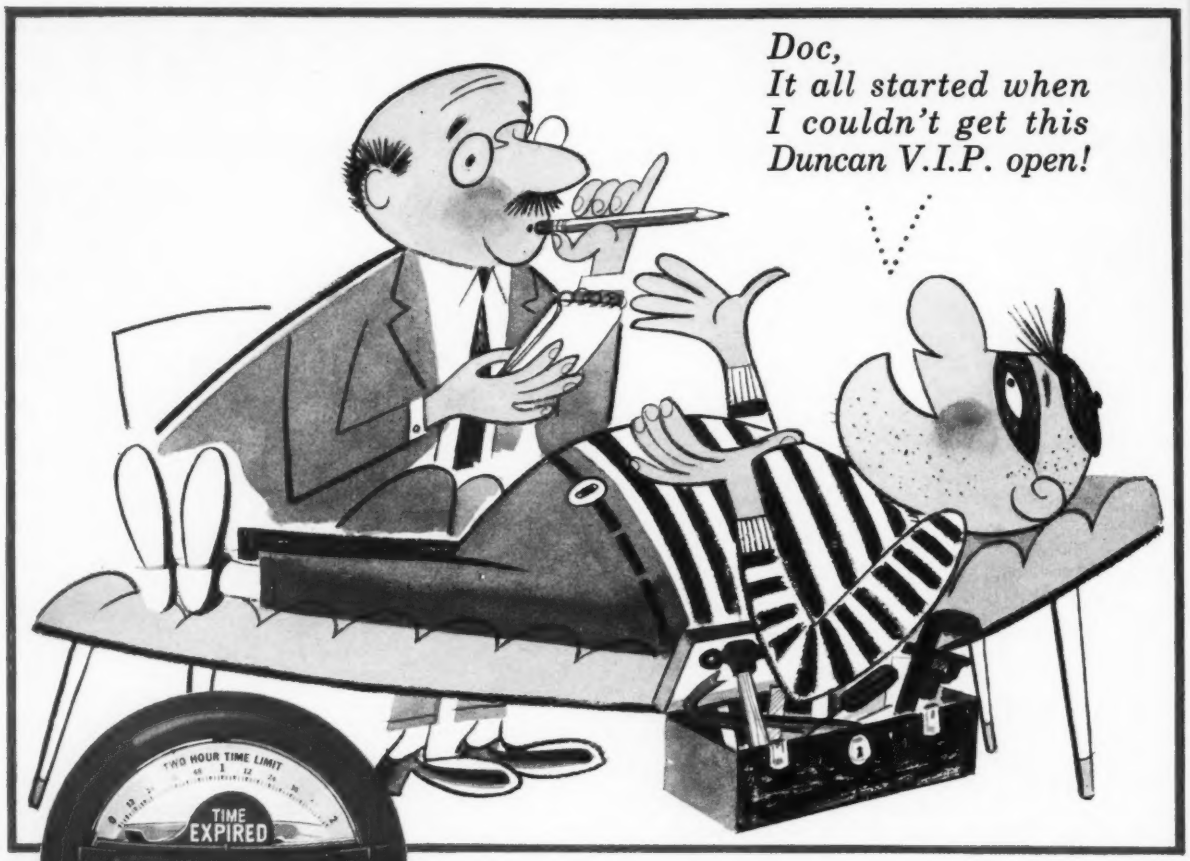

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COVER: Median guard rail on the New Jersey Turnpike, soon to be extended for the full-length of the highway. Note the method of offsetting the rail from the post.
—Photo courtesy U. S. Steel Corp.

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Frankly Speaking . . .

TRAFFIC ENGINEERS, in discussing their profession, are inclined to spend considerable time reviewing their past accomplishments. This is done I am sure only because some believe that it is necessary to convince those outside the traffic engineering field that this profession is firmly established and can now stand on its own. However, the facts indicate that this relatively young profession has gained prestige and acceptance and it is no longer necessary to dwell on the past; it is more important to concern ourselves with the present and to look into the future.

As we look to the future, I think that there are two areas of concern which are extremely important. The first relates to co-operation with other agencies. The traffic engineer faces a future that will give him an unusual opportunity to demonstrate his technical competence, his common sense and his imagination. We have just begun to scratch the surface on what traffic engineering can do.

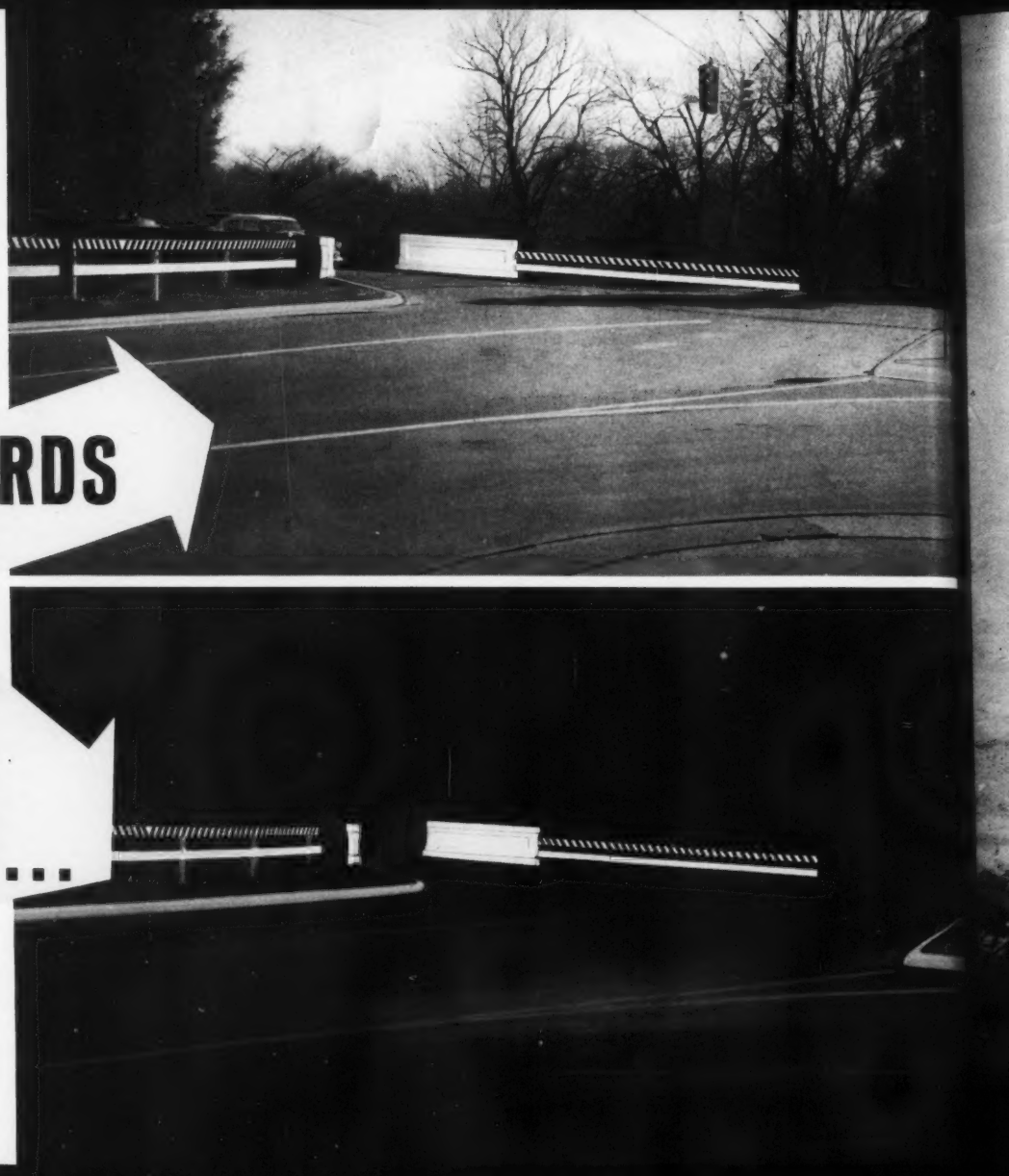
We have reached the point where the highway engineer, the planner, and the road-building industry consider the traffic engineer as an integral part of the traffic planning team. Our counsel and advice is being sought by those who have the responsibility for developing new, modern, controlled access facilities.

It has been recognized that the traffic engineer must operate the traffic facilities of this nation, and that from his operating experience and technical knowledge he is able to advise and suggest construction features and control measures that will make these new facilities considerably safer and more efficient. He is able to point out how changes in traffic patterns will create new problems on existing street systems that will require new answers. Now that the role of the traffic engineer has been established, I am concerned that we make the most of this opportunity to co-operate with others who have some responsibility in this area.

Thus again, as we look to the future we see a multitude of problems confronting the traffic engineering profession. This we should welcome because it will serve to stimulate and challenge us and will give us an opportunity to demonstrate what the profession can do. We are too few in numbers, however, to handle the problems adequately and this is the second area of concern—what can be done to induce qualified young men to enter the traffic engineering profession. We need to engage in considerably more study and research than is being conducted currently. To do this will require additional personnel. We must fill the vacancies that now exist in established traffic engineering agencies and we must provide professionally qualified traffic engineers for those cities and counties which are just now beginning to realize that they should retain such personnel.

It is my hope that during the coming year we can deal effectively with these two matters of concern. It is probable that it will be necessary only to indicate our willingness to co-operate to accomplish the first; the second depends on our ability to devise an effective program for dealing with this important problem.

ALGER F. MALO
President



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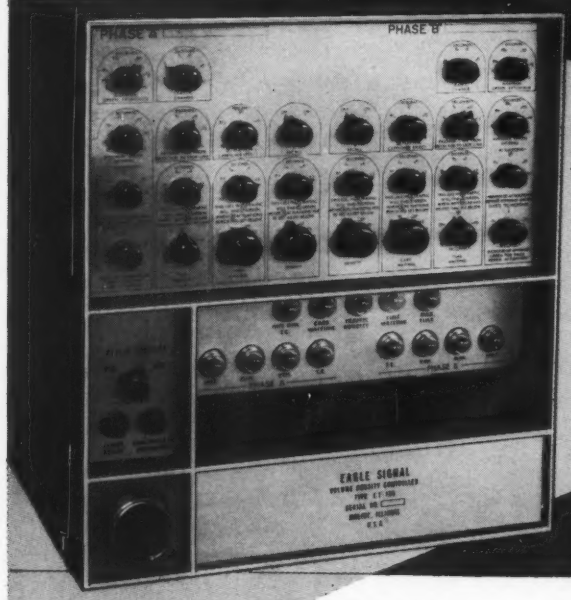

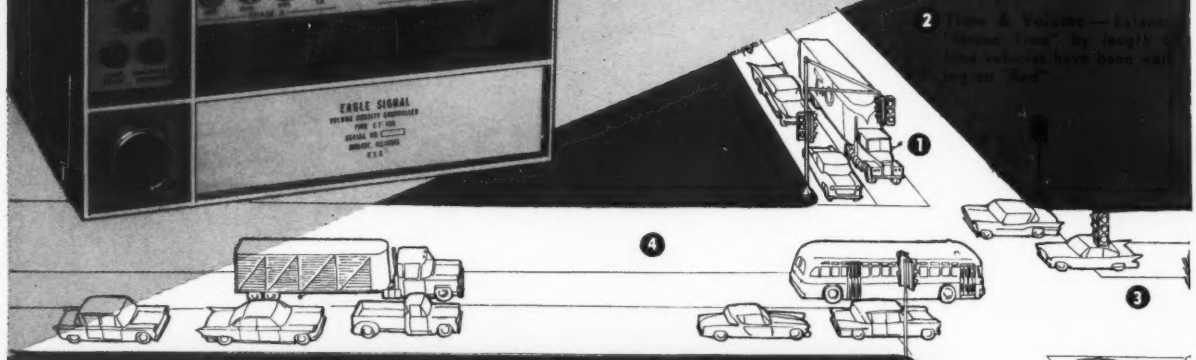

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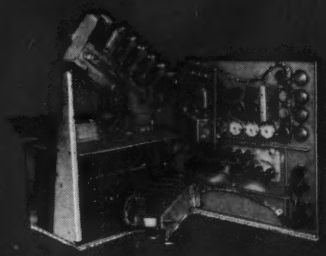

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Designing Better Freeways

By George A. Hill
District Engineer, District VII
(Formerly Ass't. Engineer of Design)
California Division of Highways

AASHO DEFINES A FREEWAY as a divided arterial highway for through traffic with full control of access and generally with grade separations at intersections. Actually, this is more of a statement of how freeway characteristics are obtained rather than a definition of the actual facility. A more general and perhaps more expressive definition of a freeway is a roadway which allows free flow of motor vehicle traffic. We have low volume, two-lane desert roads which allow this free flow of traffic, and we often say about them, "This is for all practical purposes a freeway." This free flowing facility is what we are truly designing for.

Sometimes traffic engineers refer to the traffic stream or flow as in hydraulics. Actually, the traffic stream is the movement along the road of a series of particles. These particles are self-propelled vehicles directed by intelligent, skillful individuals.

Where volumes are very low, traffic truly consists of individual particle movement. As volumes increase, the traffic stream may take on some of the characteristics of a liquid; and under extreme volume conditions, gaps reach what drivers feel is an irreducible minimum, and traffic movement may act like particles of sand being forced through a tube. Because of these changing characteristics, a particular design may be satisfactory under very heavy traffic conditions, where speeds are slow, perhaps artificially controlled, and drivers alert; but may be entirely unsatisfactory under light, high-speed, less alert driver conditions, and vice versa.

There are also important psychological factors involved in the traffic operation of freeways and interchanges. Cornell University has found that reaction time varies from approximately 14/100 of a second to familiar stimuli to from one to two seconds where interpretation and judgment are required. The ability of the human being to improve reaction time by learning and conditioning is evidenced by the fact that most people can learn to play a musical instrument and participate as a member of a band or orchestra. On the other hand, in an environment of unexpected or unpracticed situations, the response to stimulus may take two or more seconds. Thus, it seems clear that the driver can respond to familiar stimuli with almost no lost time, but there is a considerable lag in response to unusual or unfamiliar situations.

Part of highway design criteria must be that the driver be confronted with a minimum number of simultaneous choices and that ample warning be given in unusual situations or circumstances.

The traffic operational characteristics of a particular facility will vary with the traffic volume, physical characteristics, and psychological conditions which are presented to the driver. Proper design should consider all of these factors.

California has been constructing interchanges for over 20 years. During this period we have constructed a number of designs from which we have learned very definite lessons.

One of the early interchanges constructed in the State of California was the distribution structure which was constructed at the east end of the San Francisco-Oakland Bay Bridge (Figure 1).

Figure 1
Original Distribution Interchange at east end of SFOBB. Note weaving sections.

This interchange provides for traffic movements between the San Francisco-Oakland Bay Bridge and also the intersection of Highways U. S. 40 and U. S. 50. The original

Based on a talk given at Institute of Traffic Engineers Freeway Operations Seminars at Santa Barbara June 1959 and at Denver November 1959

interchange was completed in 1936. This interchange was a split three-level structure; and in order to minimize construction costs, two of the major cross movements were handled by weaving sections. These weaving sections were approximately 550 feet in length.

During the first ten to fifteen years, the structure gave adequate traffic service, although there was always some public criticism of the weaving section because of the uncomfortable feeling of drivers making this weave (Figure 2).

Figure 2
Distribution Interchange under revision.

Soon after World War II, traffic increased to such an extent that it was necessary to revise this interchange to increase its capacity and to eliminate the weaving section which had become an accident generator. A design was developed which eliminated these weaving sections, and construction was completed in 1955.

The interchange as presently revised has completely eliminated the weave and provides additional capacity through the interchange (Figure 3).

Figure 3
Revised Distribution Interchange completed in 1953.

At the present time the interchange is accommodating approximately 150,000 vehicles per day, and it is estimated that it will probably satisfactorily handle an ultimate capacity of 250,000 cars per day.

Another of our early designs is the Mission Valley Interchange, which is located in San Diego County. This interchange was constructed in 1948 (Figure 4).

Figure 4
Original Mission Valley Interchange in San Diego County.

The interchange provided four direct right-turn movements and four semi-direct left-turn connections. In order to provide these left-turn connections, two weaving sections were required. Because of the enormous increase in traffic at this interchange and because operational difficulties developed at the major weaving sections, it became necessary to revise the design at this location.

The primary revision consists of providing additional lanes on all through movements and the elimination of the major weaving sections (Figure 5).

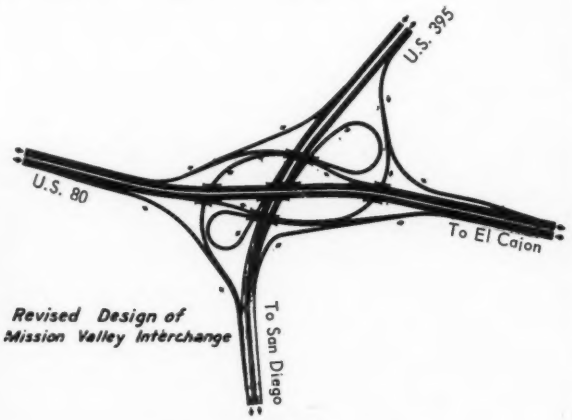


Figure 5
Revised Mission Valley Interchange.

In the revised design the direct connections have been retained for two of the left-turn movements, but it was necessary to introduce loops in order to provide for the other two left-turn movements and eliminate the major weaving sections. This revised interchange has just been completed and opened to traffic.

We have generally found from our experience with this type of interchange that the introduction of a weaving section at the interchange between major freeways to provide for left-turn movements is not satisfactory. It is also imperative that weaving sections on any portion of our freeway between on- and off-ramps should be carefully

scrutinized to make sure that they provide adequate capacity for anticipated on-off volumes. The weaving problem may also be of major consequence in metropolitan freeways where the distance between on- and off-ramps is not great and traffic volumes are extremely high.

Figures 5A and 5B show some designs that eliminate weaves by braiding the ramps.

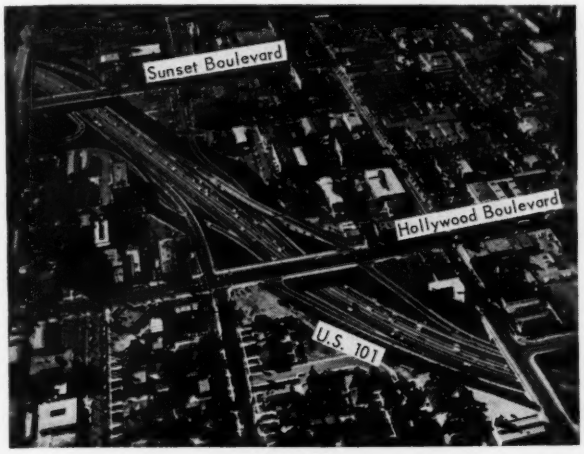


Figure 5A
Hollywood Freeway in L. A. Note braided ramps.

Figure 5B
Hollywood Freeway in L. A. Note braided ramps.

The use of shoulders on the right-hand side of the roadway is almost universally accepted and especially on heavily traveled divided freeways. Shoulders on the left are becoming a necessity and even in curbed medians, where shoulders are not available, use of the median for refuge purposes is not unusual as shown in Figure 6.

Our present policy is to provide a 5-foot all-weather shoulder on the left on all four- and six-lane freeways, and an eight-foot paved shoulder on the left on eight-lane freeways (Figure 7).

Recommended median slopes are 10:1, so that for all practical purposes, the present California practice is that full emergency shoulders are available on all divided freeways.

The next lesson occurred on the Eastshore Freeway in Oakland at the southbound off-ramp at 42nd Avenue. 42nd Avenue is a major city street with which it was necessary to make connection, and the city had a planned major improvement which ran approximately parallel and adjacent to 42nd Avenue, which also required connection from the freeway (Figure 8).

Figure 6
Use of narrow curbed median for car refuge.

Figure 7
All weather full width inside and outside shoulders on freeways.

Figure 8
42nd Ave. Interchange. Note 3 choices for southbound movement.

In the original design, the inside off-ramp provided a very inviting movement, giving preference to this move, although in actual operation the major movement was the through movement along the Eastshore Freeway. The approaching driver had three choices presented to him almost simultaneously. This design caused considerable difficulty in operation. A revision was made that resulted in the elimination of the two deficiencies of the original design (Figure 9).

42nd Ave. Southbound Off-Ramp.

Note: Preference to through movement. Distance provided between noses. Definite turning movement required on inside off-ramp.

Note: Inviting off-ramp movement giving equal preference to this move. Also simultaneous decision required by proximity of off-ramp noses.

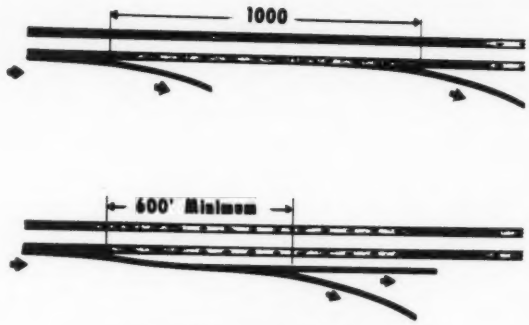
Figure 9

The left-turning movement requires positive turning action by the driver and the through route is easily recognizable. This revision also offset the noses and provides the driver with additional time between points of decision, making it necessary for him to make only one decision at a time. Advance signing was also greatly improved (Figure 10).

Figure 10
Signing for southbound movement at 42nd Ave. Interchange.

Figure 11 shows the required distances between points of decision: On the freeway where operating speeds are higher, we require a minimum distance of 1,000 feet. On ramps where speeds are lower, 600 feet is acceptable.

Another design problem which frequently arises is the problem of the location of an interchange in the immediate vicinity of an existing complicated street intersection pattern. Sometimes it may appear logical to locate an interchange in the immediate vicinity in the intersection



DESIRABLE DISTANCE BETWEEN POINTS OF DECISION

Figure 11

of major streets, as these are generally major traffic distributors. However, the addition of the freeway itself and the necessary ramps greatly complicates the existing intersection, and a difficult traffic problem generally arises. Figure 12 shows the intersection of the North Sacramento Freeway and Marconi Avenue, with the rather complicated street pattern which converges on the interchange. This case required extensive and complicated signalization for its operation.

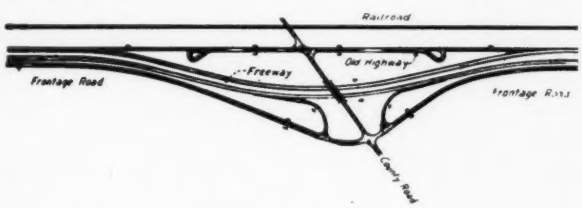
Figure 12
Multiple intersections at Marconi Ave. Interchange.

Figure 13 shows the interchange on the Hollywood Freeway at Barham Boulevard, where a northbound off-ramp terminated at the intersection of two more or less parallel facilities. In this case, it was necessary to close the off-ramp and provide service by relocating the off-ramp south of Barham Boulevard and connecting it into the parallel frontage road. This eliminated one leg in this complicated intersection.

Another design problem with which we have been confronted results from the location of the freeway parallel to and adjacent to another barrier type facility, such as a railroad. In the past, with the railroad providing a barrier which had already severed the area and would provide an economical means of access control, location parallel and adjacent to the railroad of ordinary highways or expressways had considerable advantage. When the

Figure 13
Complex intersection at Barham Ave. Interchange on the Hollywood Freeway.

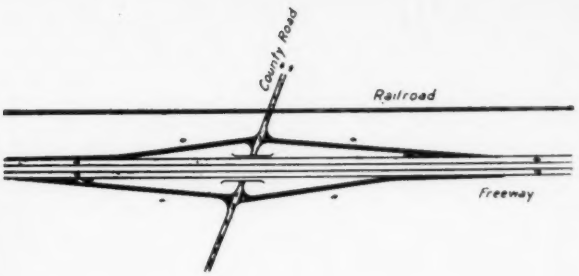
highway type of facility was improved to full freeway standards, the problems of providing satisfactory interchanges adjacent to the railroad were of such magnitude that at many times it was more economical to relocate away from the railroad. Figure 14 shows one case where the highway was relocated away from the railroad in order to provide a satisfactory interchange with a local cross road. This type of interchange treatment retains the grade crossing of the railroad and the local road; however, it provides a type of facility that, if in the future it becomes necessary to separate the local road and the railroad, it will be possible to do so.



Jacktone Road Interchange

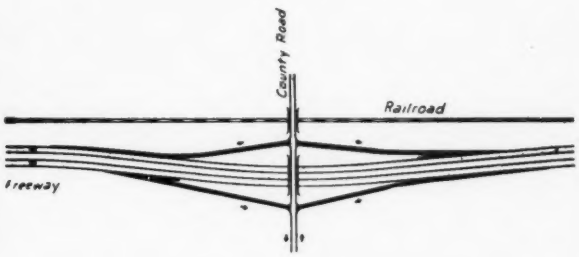
Figure 14

Figure 15 shows a diamond-type interchange where the freeway is elevated and parallels the railroad. This provides a reasonably satisfactory interchange. However, it is almost impossible in the future ever to separate the local road and the railroad crossing. Where the railroad traffic is heavy or of high speed or where the cross road traffic is heavy, it is now our policy as part of the interchange to initially separate the local road and the railroad (Figure 16).



County Road Interchange
County Road and Railroad Intersect at Grade

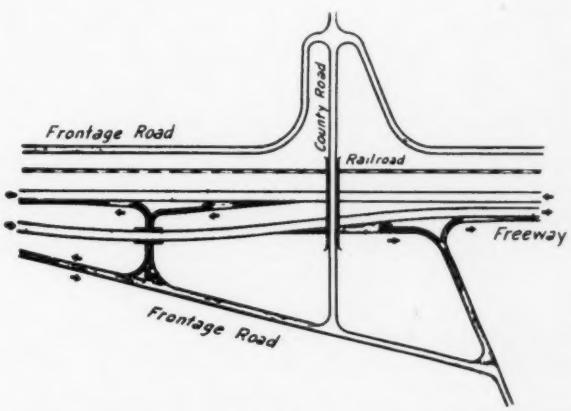
Figure 15



County Road Interchange
with Separation at the Railroad

Figure 16

An interchange commonly called the "Buhach" type, named after the county road which crossed the freeway, is an interesting type (Figure 17).



Buhach Type Interchange

Figure 17

However, it includes a left-hand off- and on-ramp and is no longer considered a satisfactory design because of the difficulty of taking traffic on and off of the high-speed lanes, the adverse effect on capacity on the inner lanes, and the acceptance of drivers that the right-hand lane is for slow traffic and provision of necessary on- and off-movements.

Figure 18 shows the off-ramp from Route 26, which was constructed through Banning. Although of reasonably high standards (a 300-foot radius curve on the structure over the opposing lanes), this ramp developed considerable accident trouble.

Figure 18
Off-ramp to Banning.

Figure 19 shows the treatment which was necessary to improve this facility so that reasonably acceptable operation resulted.

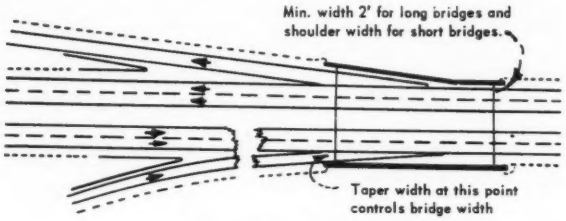
Figure 19
Pavement treatment and signing at off-ramp to Banning.

Another design problem with which we have been confronted is the positive choking effect of the on-ramp taper which sometimes results from the construction of a tapered on-ramp on a bridge. Figure 20 shows the on-ramp from Vermont Avenue to the Hollywood Freeway. The bridge rail forces the on-ramp vehicles onto the freeway lanes. This on-ramp and freeway are both carrying heavy volumes and have created an unsatisfactory traffic condition.

Figure 21 shows our present standards for the treatment of speed-change lanes on structures which eliminate this choking effect. This so-called choking off effect also occurs where a lane is dropped on the freeway.

On the Bayshore Freeway at the Army Street Interchange, because of heavy on- and off-volumes, a freeway lane was dropped through the interchange (Figure 22). The lane drop was made at the off-ramp where anticipated

Figure 20
Choking effect on off-ramp taper at structure on Vermont Ave. Interchange.

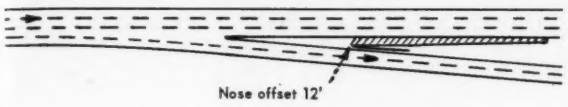


TREATMENT OF SPEED CHANGE LANES ON STRUCTURES
Figure 21

Figure 22
Army Street Interchange on Bayshore Freeway.

heavy volumes left the freeway. However, periodically motorists inadvertently got into the off-ramp and in trying to get back onto the freeway, created considerable traffic difficulty and, sometimes, accidents. Figure 23 shows a tapered section beyond the nose of the off-ramp of the freeway. This is what is known as an "escape hatch".

In the designing of a freeway, where heavy on- and off-ramps are anticipated by traffic forecasts, it seems logical to use what is called balanced design. That is, a lane is dropped where the off-movement occurs and a lane added where its heavy on-ramp movement comes on (Figure 24). This type of design appears very logical. However, the



ESCAPE HATCH DESIGN FOR
A BRANCH CONNECTION

Figure 23

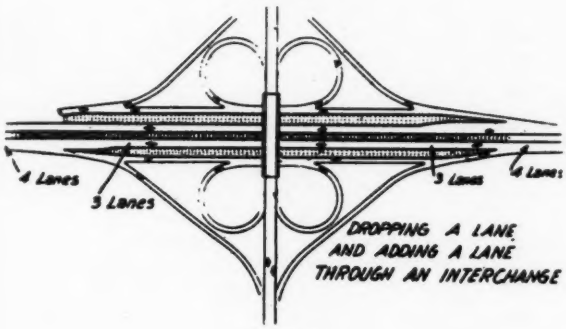


Figure 24

traffic forecasts for ramp movements have not been of sufficient accuracy to warrant the dropping of a lane with attendant difficulties that result when anticipated ramp volumes do not occur and from the required lane changing by all traffic in the right-hand lanes. It is our present practice not to drop lanes on the freeways through interchanges except when interchanging with another full freeway.

From traffic operational studies, we have found that single lane on- and off-ramps, when properly designed, can carry as high as 1,800 vehicles per hour (Figure 25). These volumes are as high as it is practical to take on and off the freeway at any one point, and the operational characteristics of single-lane on- and off-ramps are far superior to two-lane off-ramps. It is our present policy not to provide two-lane off- and on-ramps except at branch-type connections where, in effect, the facility being serviced by the ramp is of almost equal importance to that of the freeway itself.

Figure 25
Example of Single Lane on- and off-ramps.

Another difficulty we have had in design is the wrong-way usage of off-ramps where an off-ramp terminates on a two-way street parallel to the freeway and the off-ramp (Figure 26).

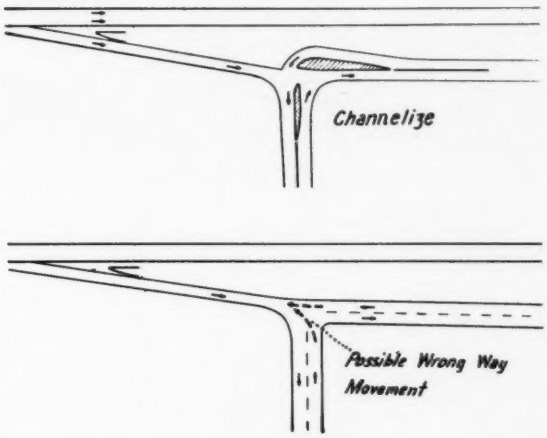


Figure 26

We channelize the intersection so that it is difficult or almost impossible for a vehicle to inadvertently go up the off-ramp in the wrong direction.

Another type of problem that we have had is with the so-called "hook" ramps where the ramp terminates with a parallel facility close to the freeway (Figure 27).

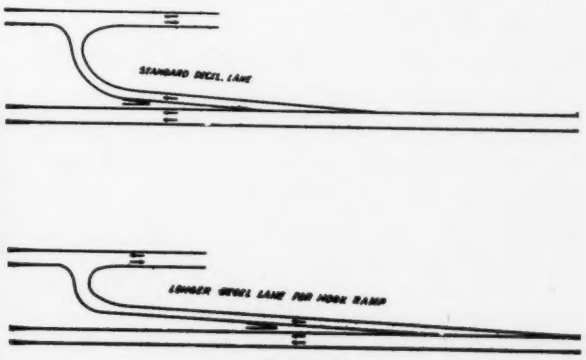


Figure 27

It was found from our operational studies that it is necessary to provide an adequate deceleration lane beyond the nose of the off-ramp before starting the sharp curvature necessary to connect to the local road. This requirement is especially accentuated by downgrades on the ramps.

Another detail of design, however, a fairly important one, is the treatment of freeway ramp noses. In the past, we have allowed the ramp noses to terminate either 2 feet off the freeway lane or the full shoulder width (Figure 28). It seems illogical to expend considerable sums to provide a clear shoulder width elsewhere and then constrict the width at ramp locations. All ramp noses now must be clear of the full shoulder width.

Figure 28
Nose encroachment on shoulder area.

A rather unusual secondary problem has arisen at the interchange with U. S. 395 in San Diego County at Clairmont Mesa Boulevard (Figure 29).

Figure 29
Clairmont Mesa Blvd. Interchange in San Diego County on U. S. 395.

Here, because of extremely heavy peak hour traffic induced by Convair's Astronautics Plant, a very unsatisfactory weave occurs off the freeway but within the interchange area. Off-ramp traffic trying to go north experiences great difficulty weaving across the Convair-bound traffic from Clairmont Mesa Boulevard (Figure 30).

These problems arise at interchanges where heavy peak hour volumes occur and must be considered by the designer in his freeway interchange design. Probable solution here is the construction of an extension of the off-ramp to the north to eliminate this weave.

In summary, we would like to restate some of the important factors in our freeway design:

1. Avoid weaving to provide for major turning movements and scrutinize carefully all freeway designs for possible restrictive weaving sections.

2. Present the freeway driver with only one decision at a time and separate decisions by a reasonable distance to allow for adequate reaction time.

3. Turning movements should normally be made from the right lane and should require positive action by the driver.

4. The motorist should be presented with consistent, familiar situations at points of decision.

Figure 30
Clairmont Mesa Blvd. Interchange in San Diego County on U. S. 395.

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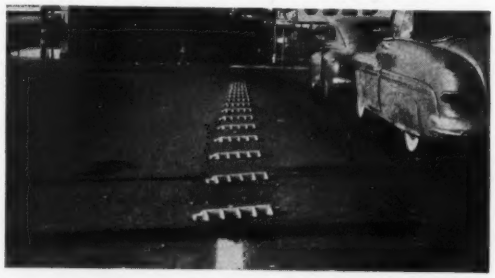

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Simulation - Its Application to Traffic Engineering

By Martin Wohl
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Department of Civil and Sanitary Engineering
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Part II

Correction

In Part I, on page 17, col. 3, of August *Traffic Engineering*, the formula should read:

$t = \tau - (T/N - \tau) \log (1 - P)$.

SIMULATION WAS DEFINED and the major steps of the simulation process were explained in some detail in Part I of this paper.[1] This second part will trace the steps of a simulation program which deals with a specific design problem in order to illustrate in more precise terms how simulation "works" and its utility to the engineer.

The freeway merging section has been selected as the illustrative example. It was chosen primarily for the purpose of introducing the concept of simulation as an engineer's tool and of demonstrating the steps or process to be followed in applying the technique rather than for the purpose of obtaining accurate results. Also, this particular example was chosen as it encompasses most of the aspects of a general simulation program, and yet can still be handled with relatively simple concepts. Parts of the program include probability models from which solutions are derived by use of the Monte Carlo technique, though most of the relationships are expressed in logical rather than mathematical terms.

Simulation of Freeway Merging Area

Statement of Problem, Measures of Effectiveness, and Assumptions

The purpose of this simulation program is to simulate the movement of freeway and ramp vehicles within a freeway merging area (that is, where an entering or on-ramp intersects the freeway) and to determine the average delay and back-up of ramp vehicles entering the freeway. Also, this simulation experiment permits determination of the capacity of the entering ramp. Thus for this particular problem there are two measures of effectiveness (or F.O.M.'s[2]), average delay and back-up of ramp vehicles entering the freeway flow. The program is so written that F.O.M. values can be determined for any combination of ramp and freeway volumes and for any distribution of gap acceptance times (that is, for any distribution of freeway gaps that are required by ramp vehicles in order to merge).

A number of assumptions have been made in preparing this freeway merging simulation program. These assumptions have been made to avoid excessive detail and thus to simplify this demonstration. While these assumptions may cause this particular program to produce inaccurate results (i.e., inaccurate F.O.M. values), they do not affect the general simulation process. The major simplifying assumptions are summarized below.

1. The merging area is considered to be sufficiently remote from traffic generation sources and traffic controls as to allow the freeway and ramp vehicles to approach the intersection in a random fashion.

2. Freeway vehicles will always be given preference; thus, when conflicts exist (between ramp and freeway vehicles) only ramp vehicles will be delayed upon entrance into the freeway traffic flow.

3. Freeway vehicles will not shift lanes *within* the merging area; thus only the outside lane of traffic (for a multi-lane freeway) must be considered, and the area can be represented by a single-lane freeway and single-lane ramp.

4. When looking for an acceptable gap in the freeway flow, the ramp vehicle will be considered either moving or stopped (delayed), and a different distribution of acceptable gaps will be used for each case.

5. First-in-line ramp vehicles which are stopped while waiting for freeway entrance suffer a 5 second acceleration loss upon entering the freeway flow; ramp vehicles which are delayed but enter *directly* from a second-in-line position have the same acceleration loss. When a first-in-line vehicle is delayed, there is an additional 3.0 second starting reaction delay upon starting

2 Figures of Merit

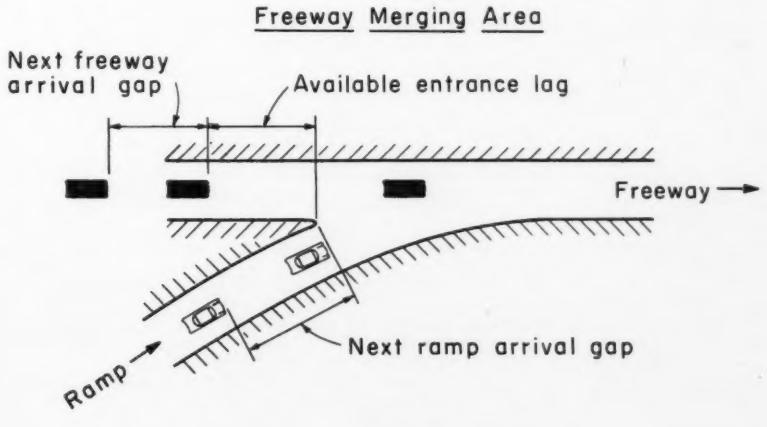

FIGURE 1

1 See: TRAFFIC ENGINEERING, Aug. 1960 pp. 13 ff.

to enter the freeway; for a second-in-line delayed vehicle there is a 2.0 second starting reaction delay when entering directly from this position.

6. Ramp vehicles which are delayed by the freeway vehicle directly ahead upon entering the freeway suffer a delay of 2.0 seconds.

Determination of Freeway Merging Section Elements

The assumptions above allow us to characterize the freeway merging section in terms of only five elements.

1. Acceptable low-relative-speed (LRS) entrance gap (i.e., moving vehicle case); see below.
2. Acceptable high-relative-speed (HRS) entrance gap (i.e., stopped vehicle case); see below.
3. Next freeway arrival gap
4. Next ramp arrival gap
5. Available entrance gap (or lag)

Figure 1 is a graphic representation or definition of three of these elements. The available entrance gap (or lag)[3] is that time gap (or lag) in the freeway flow that is available for a waiting ramp vehicle to enter the freeway flow. The next freeway arrival gap is the time spacing between two successive freeway vehicles. Similarly, the next ramp arrival gap is the time spacing between two successive ramp vehicles (based upon their original arrival times at the ramp and prior to any delays or queuing).

"Acceptable entrance gap" is used to define the size of gap or lag in the freeway flow that will be accepted by a ramp vehicle in order to make an entrance. Two kinds of acceptable entrance gaps are used, low-relative-speed (LRS) and high-relative-speed (HRS) gaps. The LRS gap is used to define the entrance gap which moving or non-delayed ramp vehicles will accept for entrance into the freeway flow, while the HRS gap is used to define that one which delayed or stopped ramp vehicles find necessary in order to enter. However, a second-in-line ramp vehicle who was waiting-in-line and enters the freeway flow *directly* from that position may utilize a LRS acceptable gap.

Formulation of Model and Evaluation of F.O.M. Values

The general philosophy and some of the mechanics of the model can best be described by following through the example of Figure 2. In this example the experiment starts at some arbitrary time, such as T = 0000. The first step is to generate the next ramp arrival gap (8 secs.) and the next freeway arrival gap (5 secs.) and to determine the times at which the next ramp and freeway vehicles will arrive at the nose of the ramp; these steps are indicated in part (a) of Figure 2.[4] The driver of the ramp vehicle bases his decision on whether or not to enter the freeway upon his expected arrival time at the nose of the ramp and the availability of a proper freeway gap. If at the arrival time of the ramp vehicle at the nose there is an acceptable gap in the freeway flow, he will enter. If not, he will be delayed and must wait for a

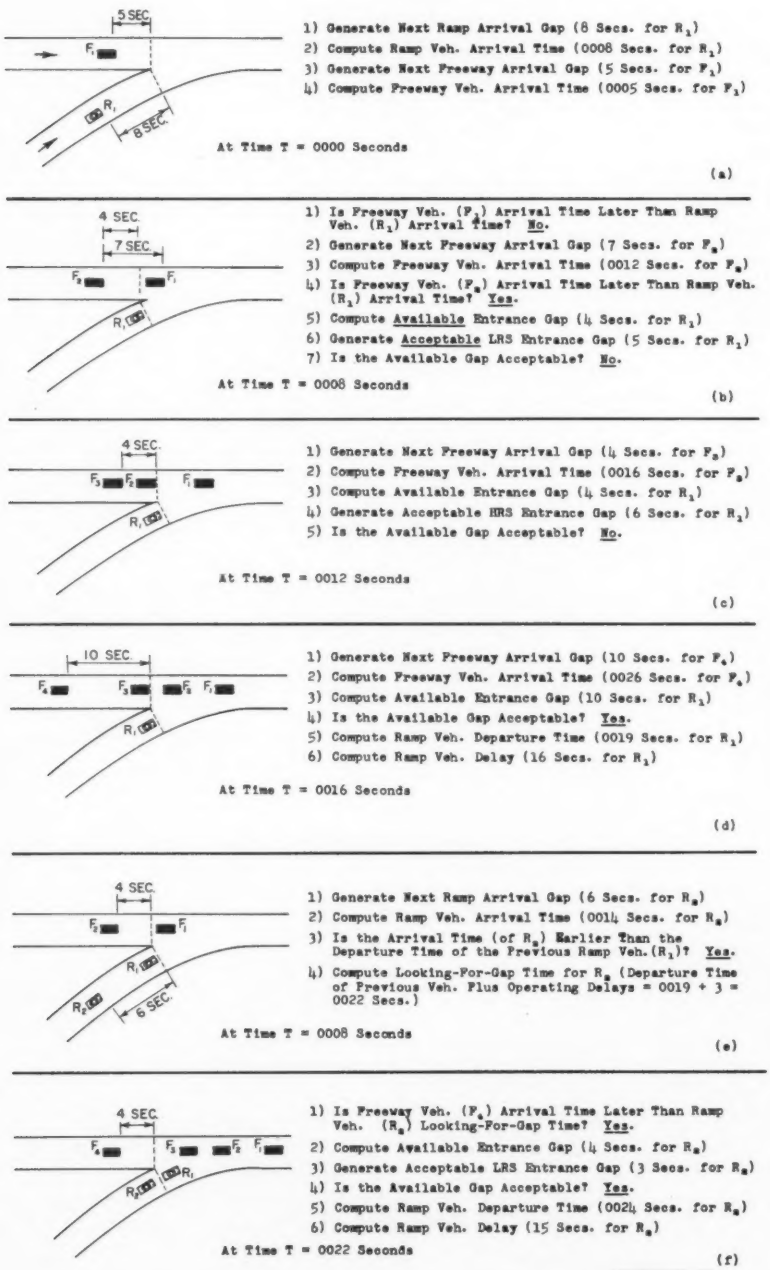
5 SEC.
8 SEC.
1) Generate Next Ramp Arrival Gap (8 Secs. for R1)
2) Compute Ramp Veh. Arrival Time (0008 Secs. for R1)
3) Generate Next Freeway Arrival Gap (5 Secs. for F1)
4) Compute Freeway Veh. Arrival Time (0005 Secs. for F1)
At Time T = 0000 Seconds
(a)
4 SEC.
7 SEC.
1) Is Freeway Veh. (F2) Arrival Time Later Than Ramp Veh. (R1) Arrival Time? No.
2) Generate Next Freeway Arrival Gap (7 Secs. for F2)
3) Compute Freeway Veh. Arrival Time (0012 Secs. for F2)
4) Is Freeway Veh. (F2) Arrival Time Later Than Ramp Veh. (R1) Arrival Time? Yes.
5) Compute Available Entrance Gap (4 Secs. for R1)
6) Generate Acceptable LRS Entrance Gap (5 Secs. for R1)
7) Is the Available Gap Acceptable? No.
At Time T = 0008 Seconds
(b)
4 SEC.
1) Generate Next Freeway Arrival Gap (4 Secs. for F3)
2) Compute Freeway Veh. Arrival Time (0016 Secs. for F3)
3) Compute Available Entrance Gap (4 Secs. for R1)
4) Generate Acceptable HRS Entrance Gap (6 Secs. for R1)
5) Is the Available Gap Acceptable? No.
At Time T = 0012 Seconds
(c)
10 SEC.
1) Generate Next Freeway Arrival Gap (10 Secs. for F4)
2) Compute Freeway Veh. Arrival Time (0026 Secs. for F4)
3) Compute Available Entrance Gap (10 Secs. for R1)
4) Is the Available Gap Acceptable? Yes.
5) Compute Ramp Veh. Departure Time (0019 Secs. for R1)
6) Compute Ramp Veh. Delay (16 Secs. for R1)
At Time T = 0016 Seconds
(d)
4 SEC.
6 SEC.
1) Generate Next Ramp Arrival Gap (6 Secs. for R2)
2) Compute Ramp Veh. Arrival Time (0014 Secs. for R2)
3) Is the Arrival Time (of R2) Earlier Than the Departure Time of the Previous Ramp Veh. (R1)? Yes.
4) Compute Looking-For-Gap Time for R2 (Departure Time of Previous Veh. Plus Operating Delays = 0019 + 3 = 0022 Secs.)
At Time T = 0008 Seconds
(e)
4 SEC.
1) Is Freeway Veh. (F4) Arrival Time Later Than Ramp Veh. (R2) Looking-For-Gap Time? Yes.
2) Compute Available Entrance Gap (4 Secs. for R2)
3) Generate Acceptable LRS Entrance Gap (3 Secs. for R2)
4) Is the Available Gap Acceptable? Yes.
5) Compute Ramp Veh. Departure Time (0024 Secs. for R2)
6) Compute Ramp Veh. Delay (15 Secs. for R2)
At Time T = 0022 Seconds
(f)

Figure 2

3 A gap is the time-spacing between two successive freeway vehicles, whereas a lag is the remaining portion of a freeway gap when a ramp vehicle arrives at the nose between the arrivals of two freeway vehicles.

4. The numbers used in this example were chosen arbitrarily for illustrative purposes. More will be said in other sections as to how the individual gap sizes, etc., can be selected.

later gap in the freeway flow. Part (b) shows the positions of the first ramp and freeway vehicles at the arrival time of the ramp vehicle at the nose. Since the first freeway vehicle had passed the nose prior to the arrival of the first ramp vehicle, the next freeway arrival gap (7 secs.) and its arrival time at the nose (0012 secs.) must be determined; also, we must check to insure that this freeway arrival time (0012 secs.) is later than the ramp arrival time (0008 secs.). Since it is, the *available* entrance lag or gap (that is, the gap available for the ramp vehicle to enter the freeway flow) must be computed (it is 4 secs.). (If the freeway arrival time is not later than the ramp arrival time, successive freeway arrival times must be determined until we have located the first one with an arrival time later than that of the ramp vehicle.) Following this, the *acceptable* LRS entrance gap (5 secs.) for the ramp vehicle must be "generated".[5]

Since the available entrance lag is not acceptable, the ramp vehicle will be delayed at least until the second freeway vehicle passes. Part (c) of Figure 2 shows the vehicle positions at the arrival time of the second freeway vehicle at the nose (0012 secs.); at this time the ramp vehicle examines the next freeway arrival gap (4 secs.), which in this case is also the available entrance gap. Since the ramp vehicle has been delayed, we must determine its acceptable HRS gap (6 secs.). Again, the available entrance gap is not acceptable to the ramp vehicle, and another freeway gap must be examined.

Part (d) shows the vehicles at the time when the third freeway vehicle arrives at the nose. The next freeway arrival gap (10 secs.) is determined, and the freeway arrival time of the fourth freeway vehicle (0026 secs.) computed. The available entrance gap (10 secs.) is larger than the acceptable HRS gap (6 secs.); therefore, the ramp vehicle can accept the gap and enter the freeway. The departure time (0019 secs.) for the ramp vehicle is the third freeway vehicle arrival time (0016 secs.) plus operating delays (3 secs.) to account for the starting reaction delay, etc. The final step is to compute the ramp vehicle delay, which is its departure time (0019 secs.) minus its original arrival time at the nose (0008 secs.)[6] plus 5-second acceleration delays upon entering the freeway flow. Thus the total delay is 16 seconds.

The second ramp vehicle cannot enter the freeway until some time following the departure of the first ramp vehicle. However, the second ramp vehicle may have arrived on the ramp earlier than the departure time of the first and have been waiting in queue. Since we are primarily concerned with delays to ramp vehicles which enter the freeway flow, the original times of arrival of the ramp vehicles at the nose[7] must be computed as well as the times at which the ramp vehicles actually entered the freeway flow. Thus in part (e) of Figure 2 the first two steps are to "generate" the next ramp arrival gap (6 secs.) and then to compute arrival time of the second ramp vehicle (0014 secs.). Following this, it must be determined whether or not the ramp vehicle was delayed by the previous ramp vehicle; that is, "Is the arrival time (of the second ramp vehicle) earlier than the departure time of the previous ramp vehicle?" If the ramp vehicle was delayed by the previous one, the earliest time that the ramp vehicle can actually begin looking for an acceptable freeway gap must be calculated on the basis of the departure time of the previous ramp vehicle. Consequently, the so-called "looking-for-gap" time of the second ramp vehicle (0022 secs.) is equal to the departure time of the previous ramp vehicle (0019 secs.) plus operating delays (3 secs.) to allow for perception and reaction times, etc.

The next step is to determine the earliest freeway vehicle arrival time that is later than the looking-for-gap time of the second ramp vehicle. In this case we find that the last computed freeway vehicle arrival time (0026 secs. for the fourth freeway vehicle) is later than the looking-for-gap time of the second ramp vehicle (0022 secs.); therefore, the available entrance lag is the difference between these two times, or 4 seconds. Based on earlier assumptions, we must compute an acceptable LRS entrance gap for the waiting ramp vehicle (3 secs.). The available entrance gap is acceptable, and the second ramp vehicle enters the freeways; see part (f) of Figure 2. Its departure time (0024 secs.) is the looking-for-gap time (0022 secs.) plus operating delays of 2 seconds; its delay (15 secs.) is the departure time (0024 secs.) minus arrival time (0014 secs.) plus 5-second acceleration delays.[8]

These steps can be repeated over and over for as many simulation trials as are desired; the number of "samples" or trials will, of course, be a function of the accuracy required, and of time and economic considerations.

The description above indicates the philosophy of this simplified simulation program, and outlines the preliminary steps necessary for the preparation of a computed program to handle the process. Each decision involving the operation of vehicles within a freeway merging section must be pinpointed and a decision rule established for each. Once these initial steps and decisions have been outlined the engineer can proceed to the more formal development of a flow chart and computer program.

The flow chart of Figure 3 formalizes the steps outlined in the previous example. Essentially, the sequence of steps in the flow chart is the same as that of the example in Figure 2, though the flow chart is generalized and somewhat more complete. The important difference, of course, is that the logic, the decisions, and the computations are organized in such a fashion that they are more readily adaptable for processing by electronic digital computer.

Some parts of the flow chart of Figure 3 may warrant explanation. First of all, the simulation program is written to provide results for all combinations of ramp and freeway volume. Therefore, the engineer can set an initial ramp and freeway volume, determine the delays associated with these volumes, then, increase or "step" the ramp and/or freeway volumes and determine their delays. The stepping of ramp and freeway volumes can be repeated over and over until some maximum desired ramp and freeway volume is reached. The reasons for this added flexibility will be discussed in a later section.

In the initialization routine the engineer must also set the simulation time for the experiment. In other words, does he want to simulate an

5 A detailed discussion of "generated" gaps will follow.

6 If it had continued without delay

7 If they could continue to the nose without delay

8 Since the ramp vehicle was delayed and entered directly from a second-in-line position (see assumption 5)

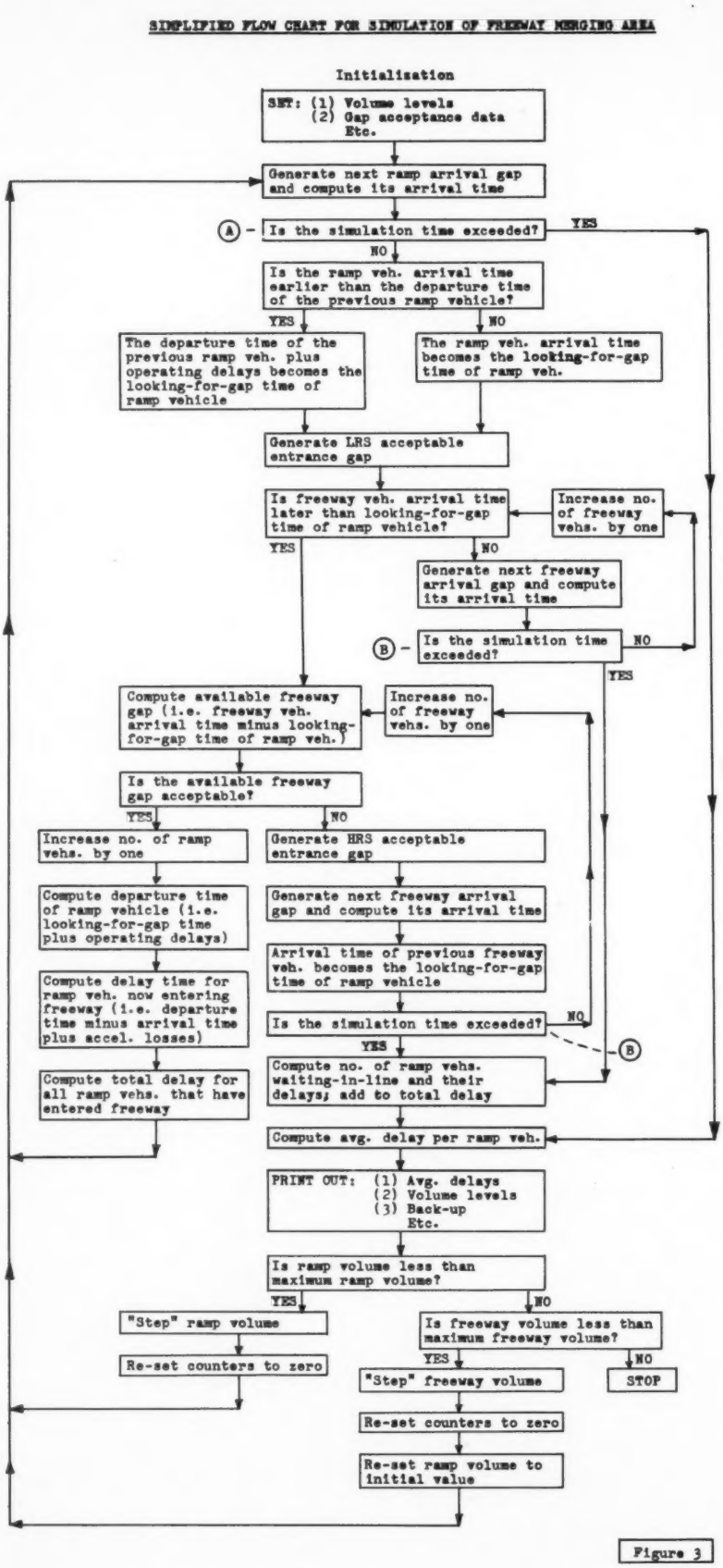
SIMPLIFIED FLOW CHART FOR SIMULATION OF FREEWAY MERGING AREA
Initialization
SET: (1) Volume levels
(2) Gap acceptance data
Etc.
Generate next ramp arrival gap and compute its arrival time
A
Is the simulation time exceeded?
YES
NO
Is the ramp veh. arrival time earlier than the departure time of the previous ramp vehicle?
YES
NO
The departure time of the previous ramp veh. plus operating delays becomes the looking-for-gap time of ramp vehicle
The ramp veh. arrival time becomes the looking-for-gap time of ramp veh.
Generate LRS acceptable entrance gap
Is freeway veh. arrival time later than looking-for-gap time of ramp vehicle?
Increase no. of freeway vehs. by one
YES
NO
Generate next freeway arrival gap and compute its arrival time
B
Is the simulation time exceeded?
NO
YES
Compute available freeway gap (i.e. freeway veh. arrival time minus looking-for-gap time of ramp veh.)
Increase no. of freeway vehs. by one
Is the available freeway gap acceptable?
YES
NO
Increase no. of ramp vehs. by one
Generate HRS acceptable entrance gap
Compute departure time of ramp vehicle (i.e. looking-for-gap time plus operating delays)
Generate next freeway arrival gap and compute its arrival time
Arrival time of previous freeway veh. becomes the looking-for-gap time of ramp vehicle
Compute delay time for ramp veh. now entering freeway (i.e. departure time minus arrival time plus accel. losses)
Is the simulation time exceeded?
NO
YES
B
Compute total delay for all ramp vehs. that have entered freeway
Compute no. of ramp vehs. waiting-in-line and their delays; add to total delay
Compute avg. delay per ramp veh.
PRINT OUT: (1) Avg. delays
(2) Volume levels
(3) Back-up
Etc.
Is ramp volume less than maximum ramp volume?
YES
NO
"Step" ramp volume
Re-set counters to zero
Is freeway volume less than maximum freeway volume?
YES
NO
"Step" freeway volume
STOP
Re-set counters to zero
Re-set ramp volume to initial value

Figure 3

hour of traffic, 30 minutes of traffic or 15 minutes of traffic, etc. Each time a vehicle arrives on the ramp or on the freeway we must check to insure that the simulation time has not been exceeded. This check serves as a mechanism to control or stop the particular simulation experiment for each level of ramp and freeway volume.

In Box A of Figure 3 the question is asked, "Is the simulation time exceeded?" This step insures that *ramp* vehicles arriving later than the simulation time limit will not be included and signals the end of the experiment for that particular volume level. In the two boxes labeled B, a check is also made to insure that *freeway* vehicles do not exceed the simulation time.

Examine the difference in the flow chart when the simulation time is exceeded for Box A and when it is exceeded for the two boxes B. If (in Box A) the simulation time is exceeded by a ramp vehicle, all previous ramp vehicles must have already entered the freeway; in other words, there can be no vehicles backed-up or queued on the ramp at the end of the simulation time. On the other hand, if (in either Box B) the simulation time is exceeded by a freeway vehicle arrival, ramp vehicles can be queued or backed-up on the ramp. In such a case, the number of ramp vehicles which are waiting-in-line on the ramp must be determined, as well as the length of time that they have been delayed or waiting on the ramp.

Two other steps in this flow chart may require further explanation:

1. "Generate the next ramp arrival gap," and

2. "Generate acceptable LRS entrance gap."

The first of these steps, the generation of arrival gaps, was discussed in some detail in the first part of this paper. Briefly, it was shown that an arrival gap "t" can be expressed mathematically as follows:

$$t = \tau - (T/V - \tau) \log (1 - P)$$

where t = Arrival gap length
τ = Minimum arrival gap (or following headway)
V = Vehicular volume during T
T = Duration of flow V (or simulation time)
P = Probability of an arrival gap length less than "t"

Thus to "generate" the next arrival gap we must generate a random frac-

tion between 0.0 and 1.0, substitute this number for the term (1 — P), and then compute "t" directly by using the formula above.[9]

The other step which bears explanation ("Generate acceptable LRS entrance gap") can best be described with the aid of Table 1 and Figure 4. The table summarizes some of the results of a study conducted at the Yale Bureau of Highway Traffic which determined acceptable LRS entrance gap lengths.[10] It includes information on the percentage of ramp vehicles which face and accept freeway gaps or lags within various ranges. In other words, none of the ramp vehicles facing 0.5 to 1.4 second freeway entrance gaps will accept them; 50 per cent of the ramp vehicles facing 1.5 to 2.4 second freeway entrance gaps will accept them and so forth.

To determine (or "generate") an acceptable LRS entrance gap[11]—and, ultimately, whether an available freeway entrance gap is acceptable or not —we can outline the steps as follows:

1. Compute the *available* freeway entrance gap.

2. If the available entrance gap is equal to or greater than that gap which all vehicles will accept (GAP_{max}), the ramp vehicle immediately accepts the available gap. If not,

3. A random number between 0.0 and 100.0 is generated.

4. The random number is compared with the acceptance percentages ($ACCEPT_i$ of Table 1) until the random number is found equal to or less than one of the acceptance percentages.

5. The mid-value of the gap range corresponding to the acceptance percentage determined above becomes the acceptable LRS entrance gap.

6. The available gap is then compared to the acceptable gap. If the available gap is equal to or greater than the acceptable gap, it is accepted and the ramp vehicle enters the freeway. Otherwise, it is rejected.

These descriptive steps are more formally stated in the flow chart of Figure 4. In the flow chart GAP_{max} (or 3.5 secs.) represents the gap size that all vehicles accept. Thus, if the available entrance gap is equal to or greater than GAP_{max} it is automatically accepted and unnecessary to "generate" an acceptable LRS entrance gap. If the available gap is less than GAP_{max} the steps involved are as described in the following paragraph.

Following the generation of a random number, it is compared successively with $ACCEPT_1$, $ACCEPT_2$ and $ACCEPT_3$ until it is found that the random number is equal to or less than the acceptance percentage of one of the ranges; the mid-value (GAP_i) of the range corresponding to this acceptance percentage becomes the acceptable gap.

As an example of the above process, suppose the *available* gap is 1.8 seconds, which is not greater than GAP_{max} (3.5 secs.). Also, assume the generated random number is 71. On comparing the random number with $ACCEPT_1$ and then $ACCEPT_2$ we find that the number is greater than both acceptance percentages; on comparing with $ACCEPT_3$ we find the random number is less than the acceptance percentage. Therefore, GAP_3 or 3.0 secs. is the *acceptable* gap. Since the available gap is less than the acceptable gap, it must be rejected. Therefore, the ramp vehicle must wait for another gap in the freeway flow, a HRS acceptable gap must be generated and the comparison repeated.

Each of these steps of the descriptive flow chart of Figure 3 must be broken down in detail such as that illustrated in Figure 4. Following this, the symbolic notation of the flow chart would be suitable for coding in a language which the computer itself can interpret. The manner in which this is accomplished varies from computer. In general, though, modern-day electronic computer technology has advanced sufficiently to permit the engineer to code his program by a system of automatic coding and to reduce the coding work required to a bare minimum.

Table 1
Freeway Merge Gap Acceptance
(Low Relative Speed)

Range No. (i)	Range of Gaps Faced by Ramp Vehs.	Mid-Value of Each Range (GAP_i)	Percentage of Ramp Vehs. Facing and Accepting Gaps in Each Range ($ACCEPT_i$)
1	0.5*– 1.4 secs.	GAP_1 = 1.0 secs.	$ACCEPT_1$ = 0.0 percent
2	1.5 – 2.4	GAP_2 = 2.0	$ACCEPT_2$ = 50.0
3	2.5 – 3.4	GAP_3 = 3.0	$ACCEPT_3$ = 84.0
4	3.5 – 4.4	GAP_4 = 4.0	$ACCEPT_4$ =100.0

*Changed by author from 0 to 0.5, since two successive freeway vehicles cannot have a 0.0 second headway

NOTE: In this case, GAP_{max} would be 3.5 seconds.
Source: Wynn, F. H., Gourlay, S. M., and Strickland, R. I., *Studies of Weaving and Merging Traffic*, Bureau of Highway Traffic, Yale University, 1948. p. 69.

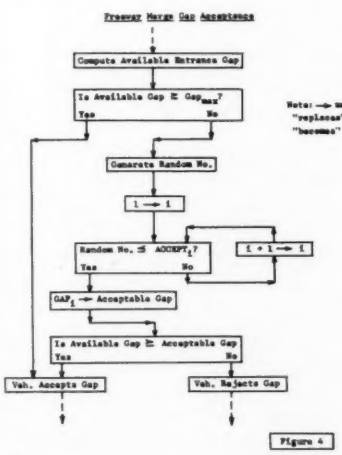

Figure 4

Comments on Results, Testing, and Data Requirements

The freeway merging simulation program which has been briefly described above was flow charted in detail and coded for the IBM 704 Electronic Data Processing Machine.[12] The simulation program was run for all levels of ramp and freeway volume from 50 to 1000 vehicles per hour, and the average delay to ramp vehicles entering the freeway was computed at each volume level. The results of this program are included as a set of curves in Figure 5. While these preliminary results may not be accurate ones, as they have not been tested, they nevertheless demonstrate the kind of results which can be obtained and the poten-

9 T, V, and τ are constants for each level of volume and must be included in the initialization routine.

10. This particular data only applies to low-relative-speed merging conditions. Also, the data is included only to indicate the **kind** and **form** of information necessary for this simulation program.

11. This may also be thought of as the minimum freeway lag or gap that a given driver will accept.

12 This work was conducted, in part, at the M.I.T. Computation Center, Cambridge, Mass.

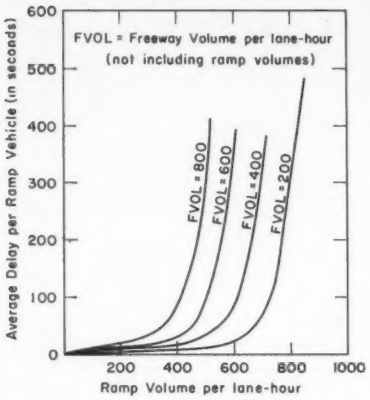

FIGURE 5

tial of simulation as a tool for the engineer.

Field testing, and data procurement and processing play an important role in simulation studies. First of all, as pointed out in the first part of this paper, it is necessary to test both the model and the solution technique in the simulation process. To do so the engineer must gather and analyze actual field data in order to insure that the model accurately represents the actions and inter-actions of the elements of the particular design situation, and to insure that the program derives an accurate solution or F.O.M. value. Needless to say, this is an important, though tedious, time consuming, and expensive part of the simulation process. It is a part which cannot be neglected or de-emphasized. Without it a simulation program may be worthless.

The data procurement and processing aspects may play still another role in the simulation process. It may not, for example, be possible to determine what the elements of the design are prior to undertaking field experiments. In addition, the actions and interactions of the various elements may be unknown prior to field testing. Two examples of this occurred in the freeway merging area simulation program in that information on the nature of arrival gaps and acceptable entrance gaps had to be determined before the model could be formulated.

Revision of the Freeway Merging Area Simulation Program and Subsequent Studies

The freeway merging program herein described represents the initial effort in preparing a more practical and useful model. Ideally, this model should be modified in order to provide more flexibility and in some cases more "realism." As the result of a research project in cooperation with the Division of Traffic and Operations, U. S. Bureau of Public Roads, the Transportation Engineering Division at M.I.T. is undertaking substantial improvement of the freeway merging area simulation program and is developing a weaving area simulation program.

Some of the other aspects of the freeway model being investigated are:

1) Dependence of minimum acceptable gaps on freeway and ramp volume.

2) Dependence of the lane distribution of freeway vehicles on ramp volume and geometric characteristics of the area.

3) Dependence of ramp vehicle delay on geometric characteristics.

Further, the model is being generalized so that:

1) Any mathematical distribution can be used for arrival gaps, rather than just the exponential distribution.

2) Distributions of ramp vehicle delay will be provided (in addition to average delay per ramp vehicle).

3) Distributions of back-up of ramp vehicles will be provided (in addition to average back-up).

A General Evaluation of Simulation and Conclusions

The remarks thus far have for the most part attempted to explain the simulation process rather than to demonstrate the potential utility of such a technique to the field of traffic engineering. However, the delay-volume curves of Figure 5 do illustrate to a limited degree its potential. The data on those graphs (average delays of ramp vehicles for 400 different combinations of ramp and freeway volumes) was obtained from approximately one hour of computer calculations; that is, 400 hours of real time (or traffic operations) were simulated in 50 minutes of computer time. That, of course, is a ratio of almost 500 to 1. As the state of computer technology increases and as our knowledge of simulation and traffic flow theory becomes greater, far more complex and intricate simulation programs can be developed with even larger ratios of real to computer time.

Simulation programs thus offer tremendous advantages to the traffic engineer. In the case above, calculated results would be available in only one hour whereas some 400 or 500 hours would be required to gather the same results in the field. The expense and time involved in gathering this amount of traffic data would obviously be large, not to speak of the problems associated with processing and analyzing the data obtained in the field. Thus as a result of simulation, theoretical and field studies can now be undertaken which heretofore would have been prohibitive because of the time, personnel and budget requirements.

One simulation program has already been fully developed and tested and is presently in use. It is the work of the Road Research Laboratory in England. This particular program was written to determine the average delay per vehicle entering a four-leg intersection.[13] While no attempt will be made

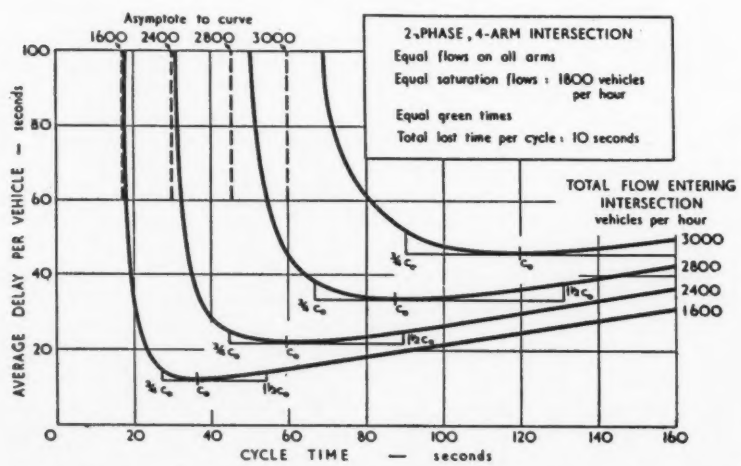

FIG. 6. EFFECT ON DELAY OF VARIATION OF THE CYCLE LENGTH [13]

[13] Webster, F. V., "Traffic Signal Settings," Road Research Technical Paper No. 39, Department of Scientific and Industrial Research Laboratory, London, 1958.

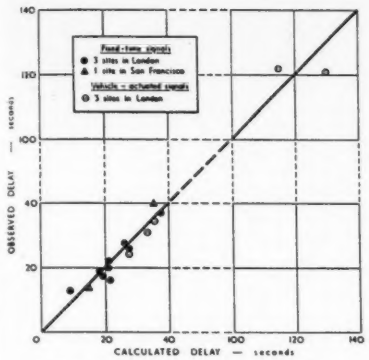

FIG. 7. COMPARISON OF OBSERVED AND CALCULATED DELAYS[23]

to summarize all of their findings, two of the items appearing in their report are included (see Figs. 6 and 7). Figure 6 shows the average delay per vehicle as a function of the cycle length of the intersection signal and as a function of the total vehicular volume entering the intersection. Information presented in the form of Figure 6 is, of course, extremely useful to a traffic engineer. First of all, it permits him to set the cycle length such that the delay per vehicle can be minimized (if, of course, this is the measure of effectiveness). Secondly, traffic engineers who conduct economic analyses can determine the average delay per vehicle at each volume level and for each trial cycle length, attach an economic value to these delays and other costs, and determine the conditions under which the return on the investment is maximized.

The question arises, of course, as to the validity of the results included in Figure 6. This question is answered in part by Figure 7, which plots *observed* delay on the y-axis and *calculated* delay (delay determined from the simulation program) on the x-axis. It is apparent that data taken from actual intersections in London and San Francisco closely approximates the calculated results, and that these "theoretical" results can be used for "practical" applications.

Other digital computer simulation studies are underway which will enable the traffic engineer to "predict" behavior on highway facilities under varying conditions of geometric design and traffic control. The utilization of this simulation work can lead to the design of more efficient highway and transportation systems, ones which will operate with greater assurance of "safe, rapid and efficient traffic movement." The burden of achieving this objective, however, lies with the practicing engineer; it is he who must make use of the simulation studies, who must understand their purpose and support the research activity so necessary to their development.

Acknowledgments

My sincere appreciation is extended to Professors A. J. Bone and A. S. Lang of M.I.T., to Mr. Daniel Brand, Research Assistant at M.I.T., and to Dr. Daniel Gerlough, Ramo-Wooldridge, for their advice and assistance in preparing these two articles; also to the Massachusetts Department of Public Works, who as sponsors of the Joint Highway Research Project at M.I.T. provided in part the funds necessary for these initial simulation studies.

References for Further Study

Churchman, C. W., et al, *Introduction to Operations Research*, John Wiley & Sons, 1957. Chapters 1, 5, 6, and 7.

(Continued on page 56)

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Measuring Lateral Placement And Velocity

By Philip H. Thompson
Instrument Engineer
Electrical Engineering Department
Minnesota Mining and Manufacturing Company
and
Matthew J. Huber
Research Associate
Bureau of Highway Traffic, Yale University

A NEW AND USEFUL SYSTEM of instrumentation for measurement of certain basic traffic characteristics was recently used with success in a field study of traffic at a Minnesota cloverleaf interchange. This instrument system provides a permanent record of data from which such traffic characteristics as speed, lateral placement, headways, and gap acceptance may be calculated. Materials used in the construction of this equipment are readily available and, with the possible exception of the recording instruments, reasonable in cost.

Speed, volume, placement and related traffic stream characteristics are customarily measured by visual observation,[1] photographic techniques,[2] or with electrically segmented road tapes[3] sealed in rubber. Each of these methods has advantages, but does not completely satisfy all the requirements for an inconspicuous, economical method that can record at multiple locations day or night.

The most successful visual observation method calls for short, longitudinal stripes at one foot increments on the pavement. Placement can be determined by the number of stripes remaining visible to the observer as a vehicle passes. Speed can be simultaneously recorded by stop watch timing. This method is very useful and convenient for daytime studies, but at night the stripes often cannot be seen well enough for accurate determination of placement. At many locations, it is also difficult to adequately conceal the observers.

Photographic methods require fixed camera locations and previous shots from the same location of the road with a placement scale of reference—usually painted on a board—temporarily held in place. Superimposition of the reference scale onto the projected image of the test film permits determination of placement. At night, reference lights can be photographed for the scale of reference rather than a painted board, and the measured vehicle's headlights used to obtain placement. However, to coordinate such measurements at night to include eight locations and subsequently analyze the film record of thousands of vehicles represents a formidable task. Accuracy at night is questionable also. Placement of the center of the vehicle can be accurately determined, but placement of the right side of the vehicle may be inaccurately calculated because of the variety of headlight locations and vehicle widths currently in use.

The electrically-segmented tape is the most positive device for night time use. It consists of a heavy, flat, rubber-encased tube containing metal strips acting as electrical switches. Twenty-pen operation recorders or digitalized adding machines have been used to record the impulses detected by the segmented tape. These tapes have the advantage of rugged construction and proven dependability. They are not readily and economically available, however, since they must be specially manufactured and cast in rubber molds. Also, for the particular purpose of this study, which included measurements on colored, brightly reflective ramp surfaces, a thinner tape was essential in the interest of eliminating conspicuity.

1 I. Fukutome and K. Moskowitz "Traffic Behaviour and On-Ramp Design", **Highway Research Board, Bulletin 235,** Washington, D. C., 1959.
2 B. D. Greenshields et al, **"Traffic Performance at Urban Street Intersections,"** Yale University, Bureau of Highway Traffic, Technical Report No. 1, New Haven, Conn., 1947.
3 J. H. Mathewson et al, "A Segmented Electrical Element for Detecting Vehicular Traffic", **Proceedings of Highway Research Board,** Washington, D. C., 1949, Vol. 29, pp. 374-383.

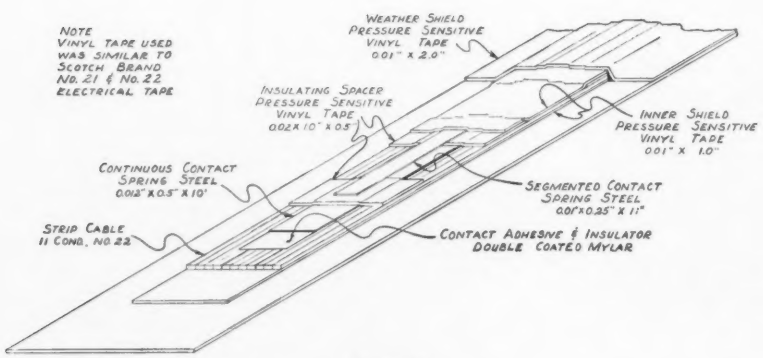

NOTE
VINYL TAPE USED WAS SIMILAR TO SCOTCH BRAND NO. 21 & NO. 22 ELECTRICAL TAPE
WEATHER SHIELD PRESSURE SENSITIVE VINYL TAPE 0.01" x 2.0"
INSULATING SPACER PRESSURE SENSITIVE VINYL TAPE 0.02 x 10" x 0.5"
INNER SHIELD PRESSURE SENSITIVE VINYL TAPE 0.01" x 1.0"
CONTINUOUS CONTACT SPRING STEEL 0.012" x 0.5" x 10'
SEGMENTED CONTACT SPRING STEEL 0.01" x 0.25" x 11"
STRIP CABLE 11 COND., NO 22
CONTACT ADHESIVE & INSULATOR DOUBLE COATED MYLAR

Figure 1
Placement tape construction.

Detector Tapes

Since most of the field observations for the studies at the cloverleaf interchange were to be made at night, and vantage points for manual or photographic recording were limited, the method that proved ultimately successful was based on the segmented tape, simply constructed of economical materials and electrically circuited to determine accurate placement and velocity. A cross-sectional diagram of the tape and identification of materials used in its construction are shown in Figure 1. A 10-foot tape of this type can be assembled in 2-3 man hours.

The sensors, as shown, consist of a 10-foot continuous strip of spring steel in juxtaposition to ten, 11-inch strips of spring steel. The shorter strips are separated from the long strip by vinyl spacers. Pressure on the sensor at any point along the unit will force one of the shorter strips into contact with the long strip. Electrical connection is made to the strips by means of a flat, 11-conductor strip cable located below them. Simple solder connections between the conductor cable and spring steel segments proved to be sturdy under traffic loads. These active parts of the unit are then sandwiched between two strips of pressure sensitive vinyl tape that serve as a protective covering. This constitutes the sensing portion of the system, ready to be installed across the highway to intercept traffic, each contact representing approximately one-foot spacing from the pavement edge or an arbitrary base line. Cost of materials for one complete tape is approximately $12.00. For field installation, the placement tapes are secured to the road surface by pressure sensitive vinyl tape (Figure 2).

A principal advantage of the tapes is their small, thin cross-section, making them particularly inconspicuous and of negligible influence on the driver (See Figures 3 and 4).

Although considerations other than durability dictated the design, the tapes were found to require little maintenance. They were installed on approximately thirty separate occasions. Over 12,000 vehicles crossed some tapes and only one case of equipment breakdown was traced to them. This was a short-circuit at the extreme tip of one tape caused by the sharp edges of the steel contacts breaking through the tape covering at that point. Re-occurrence was prevented by placing a small additional strip of vinyl tape across the end of each placement tape at the time of installation on the pavement. As an added precaution the tapes were not coiled, but were stored and carried on a 10 foot board.

Recording Device

The nature of the study for which the tapes were designed was such that it was desirable to measure the characteristics of all vehicles approaching each exit ramp throughout their deceleration, turn, and ramp travel. For on-ramps, similar data were required for vehicles slowing down, sometimes stopping, then merging with the through traffic. To obtain complete data on these turning movements, seven traps for speed and placement at each ramp to be measured were considered necessary. These traps were from 50′ to 150′ in length and spaced within several hundred feet on either side of the nose of the ramp. The shorter spacing was used at the point of turning execution. The longer traps extended beyond the speed change lane in one direction and in the ramp proper in the opposite direction. Accordingly, eight recording tapes per ramp were employed, spaced over a maximum distance of 900′. In order to record separately each of the 10 possible actuations at the eight tapes, a total of 80 separate impulse pens would be required. Further, an unwieldy cable system would be needed to complete the system. It was decided that such a system would not lend itself to the daily installation and removal required for this project.

The recording system used for this project eliminated the need for 80 separate impulse pens and large conductor cables. The recording instruments are two Model BL-202, dual pen, fast-response units, manufactured by the Brush Development Company. Information gathered by the eight sensing tapes is presented on two strip charts, each approximately 3½ inches wide. A ten-step voltage divider circuit at each tape translates lateral placement into voltage, indicated on the record as the distance of pen travel from zero. A typical pair of charts is shown in Figure 5 and the wiring diagram is shown in Figure 6. Positive pen travel is used as one channel of information and negative pen travel as a separate channel for a total of eight channels, or one for each placement tape.

Sweeps to the left of the left-hand pen zero line are indications from placement tape No. 1. Information from tape No. 2 appears to the right of this line. A vehicle proceeding through the trap will then mark the chart as it crosses each tape. This group of eight marks will then become a record of its path, the distance between marks representing the average speed between tapes and the length of the mark representing the distance of the car from the base line.

Some information is also available concerning the types of vehicles. The response speed of the recorders is such that each axle shows on the record as a separate mark. The set of marks

Figure 2
Heavy plastic pressure-sensitive tapes hold each placement tape in place. Placement tape is angled to permit separate recording of each vehicle wheel.

Figure 3
Thickness of placement tapes is only 3/16".

Figure 4
Installed tapes are relatively inconspicuous. Four tapes are shown in place on this ramp.

Figure 7
Tapes plug into master cable leading to recording instruments.

made by each vehicle type—such as tractor trailer, passenger car, etc.—results in a characteristic pattern. A manually operated button activates all four pens simultaneously for periodic recording of matching points on all channels. These match points are useful reference marks during the eventual transcription of the data from the rolls to data sheets.

The placement tape length of ten feet and the number of segments in the tape were chosen in this case as a compromise between road width and recorder resolution. Consequently, the tapes extended from the right edge of the pavement surface so as to register the maximum number of vehicles but did not extend completely across the road. There were, therefore, some vehicles that crossed the tapes with their right wheels only. To distinguish between such vehicles and the blip resulting from a vehicle crossing the tape with both wheels, it is necessary to use the placement tape installed approximately 15° from the normal to the centerline of the road (See Figure 2). Right and left wheels then cross the tape at slightly different times. This small difference in time is sufficient to influence the marking pen and each wheel produces a distinct mark on the chart. The resulting record positively registers the position of all four wheels of each vehicle.

The recording system permitted the use of an 8-conductor cable rather than an 81-conductor cable that would have been required if each of the 80 segments had been on a separate circuit. The interconnecting cable, 8-conductor, #20 AWG, was stored on a garden hose reel for easy payout and pickup. One thousand feet of cable were used on this project, connected by a 3-prong plug to each tape for ready assembly (Figure 7). The DC power convertor for the placement tapes and the recording equipment were mounted on a small cart. A small gasoline engine driven generator produced electric power for the chart motors and power supplies. Installation time for road tubes, interconnector cable and recorders, with a crew of three, was approximately an hour. The equipment could be picked up and stored in a truck in half an hour.

(Continued on page 52)

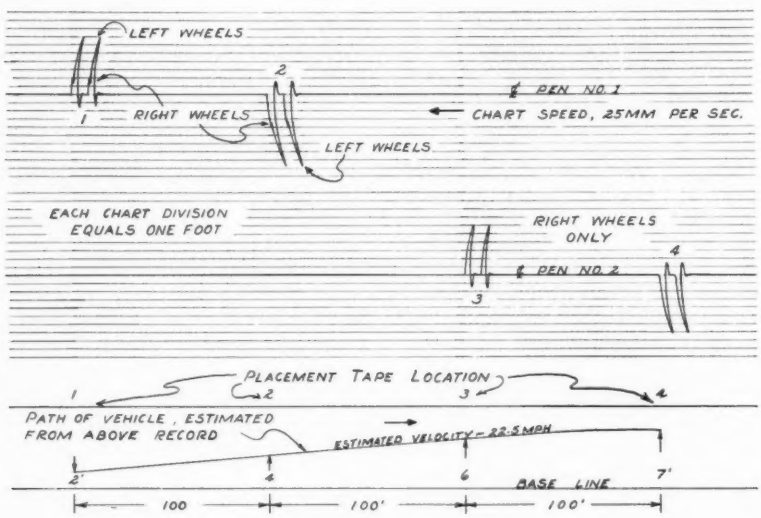


Figure 5
Typical Record.

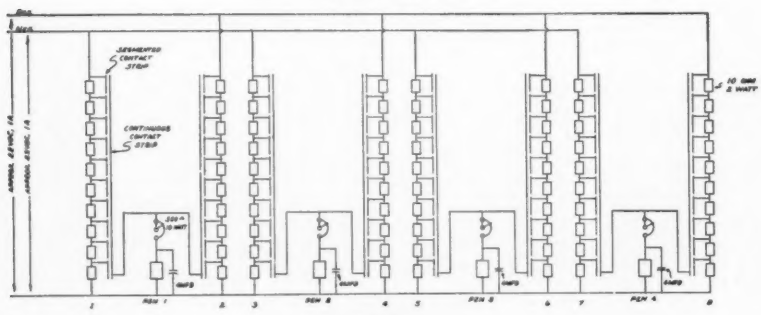


Figure 6
Elementary wiring diagram.

Freeways — A Modern Mass Transportation System

By J. W. McDonald, Manager
Engineering Department
Automobile Club of Southern California

Los Angeles freeways have been called a variety of names ranging from "an amazing transportation system" to "the world's longest parking lots." These names are indicative of the growing interest in transportation as provided and planned in the Los Angeles area with special emphasis being placed on transit and freeways. In response to this interest the following may be helpful in understanding the Los Angeles transportation picture and in evaluating the many opinions, claims, and counter-claims that have been aired regarding this subject.

A clear picture of what is happening in Los Angeles is not only important to this area, it is important throughout the country since in recent years Los Angeles has come to be known as "the most freewayed city in the world" and this characteristic is pointed to by both advocates and opponents of freeways as illustrating their respective views. Thus, Los Angeles has become a proving ground for freeways as the dominant form of urban transportation.

To begin with, take a quick, broad look at Los Angeles.

Greater Los Angeles is now the second largest metropolitan area in the United States and according to most forecasts is inevitably to become *the* largest.

Greater Los Angeles has experienced a growth unparalleled by any other metropolitan area.

Greater Los Angeles is now, and has been throughout the period of its largest growth predominatnly dependent on motor vehicle-highway transportation.

These are facts, not opinions.

In the face of these facts some continue to say that to insure the future of this area we must now turn to mass rapid transit. But it seems more reasonable that a middle course should be pursued involving both private and public transportation, each to the degree and in the form that it best can serve. Public transportation in some form is essential and should be given the opportunity to serve the real transit needs of the community. Private should not be arbitrarily curtailed. transportation is also essential and

—California Division of Highways

Figure 1—View of the future location of the San Diego Freeway looking south across the Santa Monica Mountains. Note the beginnings of a large cut in the center of the picture with Mulholland Drive running across the photo just above center. The point of interest here is the land development taking place on both sides and simultaneously with freeway construction. These lots benched into the hillside above the freeway sell for $20,000 and up, and are accommodating strictly luxury-type, custom-built homes.

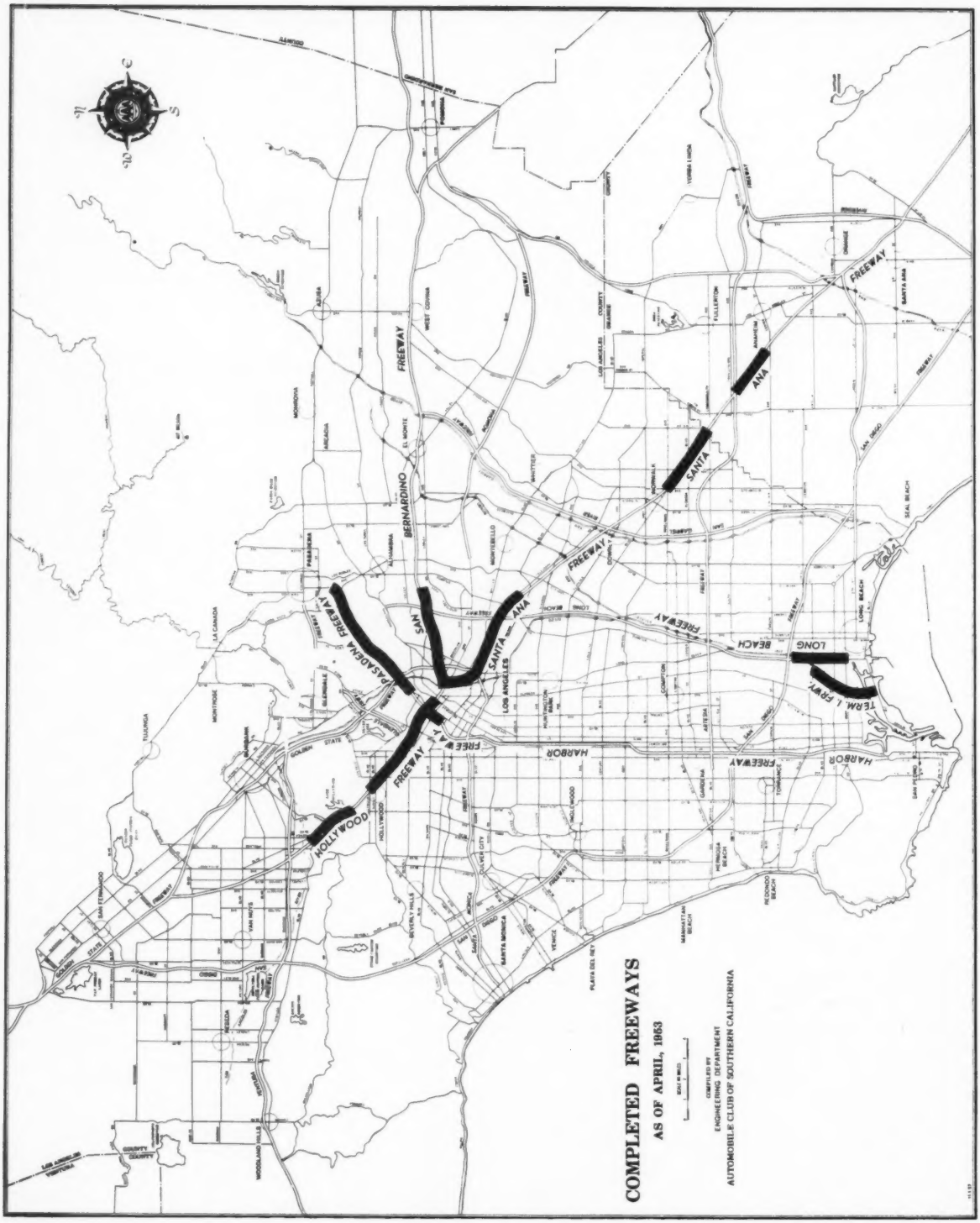
Definitions

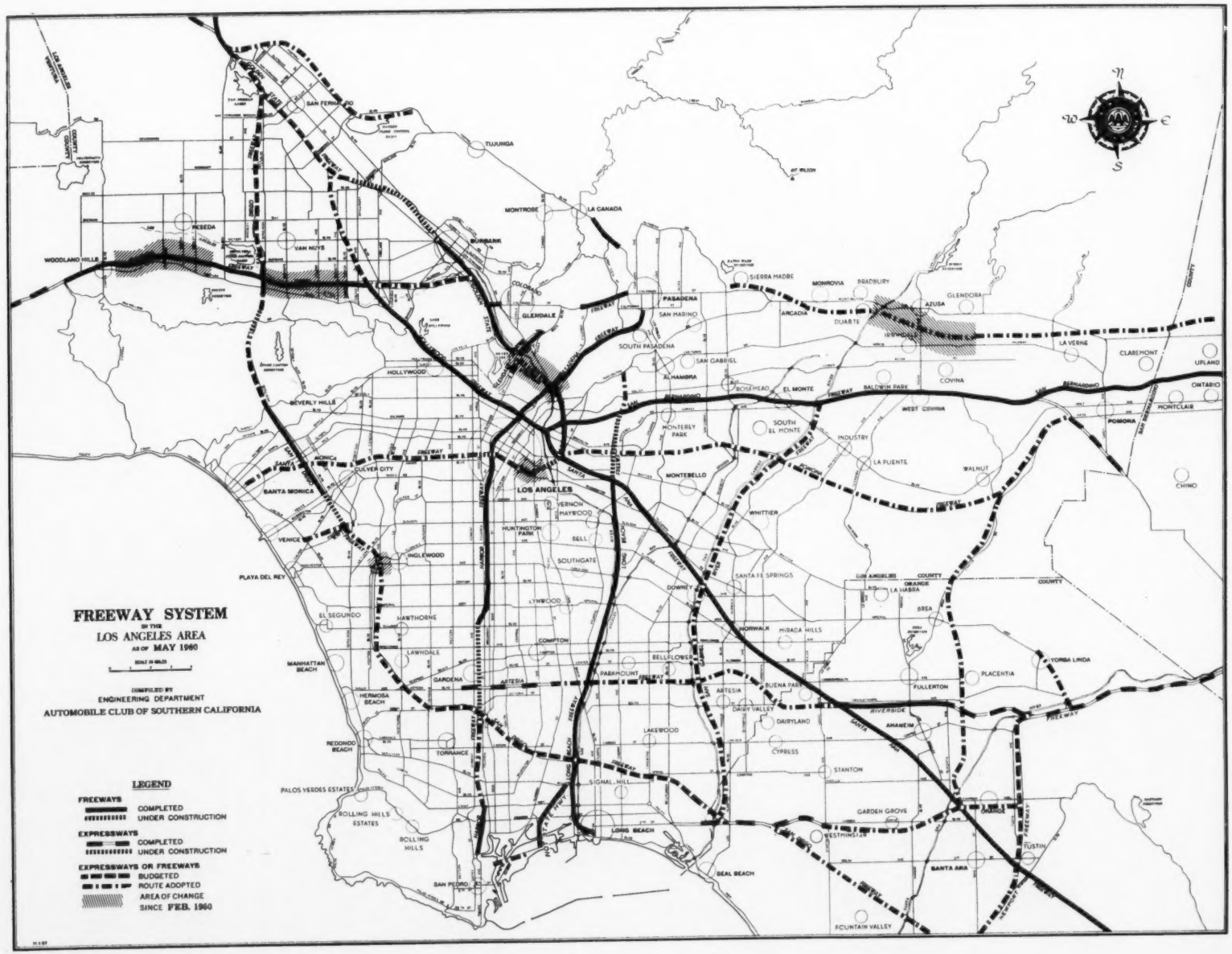
Before going any further, the matter of definitions deserves attention. The terms mass transit, rapid transit, and mass transportation often are used interchangeably and such use can lead to misunderstanding.

To avoid this, the following definitions will apply here: (It seems particularly important in discussing transportation to distinguish between the general term "transit" and the specific term "rapid transit").

Mass Transit — a general term meaning public transportation of large groups of people in vehicles operating on specified routes and schedules. Mass transit includes buses, street cars, and "rapid transit."

Rapid Transit—the more specific term meaning transit operating over exclusive, grade separated rights-of-way. Subways, overheads,


COMPLETED FREEWAYS
AS OF APRIL, 1953
COMPILED BY
ENGINEERING DEPARTMENT
AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA
SAN BERNARDINO FREEWAY
SANTA ANA FREEWAY
PASADENA FREEWAY
HOLLYWOOD FREEWAY
HARBOR FREEWAY
LONG BEACH FREEWAY
TERM. I. FRWY.


FREEWAY SYSTEM
IN THE
LOS ANGELES AREA
AS OF MAY 1960
COMPILED BY
ENGINEERING DEPARTMENT
AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA
LEGEND
FREEWAYS
COMPLETED
UNDER CONSTRUCTION
EXPRESSWAYS
COMPLETED
UNDER CONSTRUCTION
EXPRESSWAYS OR FREEWAYS
BUDGETED
ROUTE ADOPTED
AREA OF CHANGE SINCE FEB. 1960
N
W
E
S
LOS ANGELES
SANTA MONICA
BEVERLY HILLS
HOLLYWOOD
PASADENA
GLENDALE
BURBANK
LONG BEACH
TORRANCE
COMPTON
DOWNEY
WHITTIER
POMONA
ONTARIO
ANAHEIM
FULLERTON
SANTA ANA

—California Division of Highways

Figure 2—Hollywood Freeway at Vine Street, looking southeast towards downtown, showing a freeway and its impact on the aesthetics of an area. This shot is several years old now and landscaping has made the freeway even less obtrusive.

monorails are examples of rapid transit. The distinguishing feature of rapid transit then is the *exclusive right-of-way* rather than its speed. If taken literally the term "rapid transit" today is a misnomer. Most existing transit systems referred to as "rapid" actually operate at average speeds slower than we drive on the freeways even in the peak hours.

Mass Transportation is often interpreted to mean simply mass transit, but transportation includes much more than transit. Webster defines "mass" as a "large quantity". Thus, Los Angeles freeways actually constitute a modern, mass transportation system, since they provide for the movement of literally millons of people every 24 hours. The Pasadena and San Bernardino Freeways each carry about 120,000 vehicles a day, the Santa Ana 140,000, the Hollywood and Harbor Freeways over 200,000 each and 350,000 vehicles use the 4-Level Interchange daily. Even with only one or two persons per vehicle, the 4-Level Interchange accommodates over *half-a-million* Los Angeles area travelers each day of the year.

In an even broader sense "transportation" involves goods as well as people, and freeways, unlike transit, serve in this respect too. Furthermore, *freeways serve transit.* The Los Angeles Metropolitan Transit Authority has established most successful "freeway Flyer" bus routes to the San Fernando Valley and elsewhere. While not "rapid transit" by definition, the freeway bus establishes a transit service more rapid than most so-called rapid transit systems, and does so at a fraction of the cost.

While still considering definitions, return for a moment to the "middle course" mentioned earlier—which is often referred to as a balanced transportation system. "Balanced" is a good word—who will argue for an unbalanced system? But support of "balance" is too often twisted to imply that present transportation is badly *out* of balance. Is it out of balance in Los Angeles because of this area's degree of dependence on private transportation? Is it out of balance because Los Angeles has a relatively small transit system and a complete lack of, or some might say freedom from, rail-rapid transit? Certainly these are not measures of "transportation balance."

Transportation balance should be defined as the matching of transportation modes and systems to the real transportation needs of the community.

On the basis of these definitions then, it should be safe to say all are in favor of a balanced transportation system, all are in favor of public transportation, and probably all are in favor of mass transit. The need for some kind of mass transit seems evident. Also, we can see that the freeways are presently serving as a mass transportation system. One popular feeling, however, that *remains to be proven* is that this area has an immediate need for *rail-rapid* transit.

If it can be shown that rail-rapid transit could serve even part of Los Angeles' widespread population more conveniently, more efficiently and more economically than other modes of transportation—then we should have it. To date, however, convincing evidence to support this case has not been produced, while many factors indicate that rail-rapid transit has, if anything, an extremely limited potential here.

The Freeways

Now, a good look at the freeway system as it exists in Los Angeles, seems in order. To keep the observations in perspective we must look from a vantage point providing a broader view than many gain through their windshilds as they tackle the evening rush.

For instance, the two maps show the tremendous progress made by the State Division of Highways in Los Angeles area freeway development in just seven years. In 1953 the Los Angeles motorist could make no freeway trip longer than 7 miles. Today, uninterrupted trips of 90 to 100 miles are available from the San Fernando Valley to El Toro in Orange County, or to San Bernardino and on to Barstow. In all but the peak hours these trips can be comfortably traveled at average speeds approaching 60 MPH. As another example a resident of Long Beach will find that he is actually less than 30 minutes away from downtown Los Angeles via the Long Beach Freeway, and this is a 25 mile trip.

These are off-peak speeds and travel times appropriate to the periods when approximately 80% of the trips in the area are made. However, even during peak hours travel times in Los Angeles are as good, or better than those in other metropolitan areas having allegedly more efficient forms of transportation.

In 1957 the Engineering Department of the Auto Club made a comprehensive study of travel times and compared these with the results of a similar study made 20 years before. It was found that not only had travel

times during the off-peak hours improved spectacularly but we could get around at least as well even during the peak hours, and this was accomplished during a 20-year period when vehicle registration nearly tripled—the figures for Los Angeles County being about 900,000 vehicles in 1937, and 2,700,000 in 1957. The growing freeway system is obviously not leading us from bad to worse as is so often alleged.

This year the travel time study was repeated and the results were the same—indicating additional improvement in mobility as continuing growth brougth an increase of 300,000 in vehicle registration.

The freeways cost a lost of money—the 40 miles completed in 1953 cost about $130 million in construction and right-of-way. Today, the freeways shown on the map represent an investment of over $700,000,000. This investment, however, seems well justified by the benefits derived. For instance, the 40 miles of freeways shown on the '53 map have returned, in just 7 years, user savings in the form of time and reduced costs of more than twice the $130 million investment, and, because of access control, continued return is assured.

Property values have been greatly enhanced by freeway construction. The parallel surface streets are relieved of heavy, through traffic, and, probably most important, it should always be remembered that freeways provide safer travel. It is estimated that Los Angeles freeways are saving 80 lives annually.

As another example of freeway benefits in the form of reduced accidents, a recent report shows that when all U. S. 99 traffic used the old, city-street highway through Madera, in the San Joaquin Valley, 154 accidents occurred in one year. In a one-year period following opening of the new freeway there were only 48 accidents on both the former city-street route and the freeway—a 79% decrease. This experience is being repeated throughout the state and the country.

Freeways are often accused of being the despoilers of communities when actually the opposite is true. In El Monte, for instance, local objections delayed construction of the San Bernardino Freeway for several years, and all sorts of frightening predictions were made including the near-total demise of the city.

—California Division of Highways

Figure 3—The Harbor Freeway looking north from Manchester Boulevard Interchange. Note development both new and old within the loops. This is one way to reduce the amount of acreage devoted to a freeway interchange.

Now, however, several years after completion of the freeway, economic studies indicate that, by almost any measure, conditions in El Monte have improved:

The annexation rate has increased sharply.

Building permits show remarkable gains.

So-called "by-passed" business is doing significantly better than similar businesses in Los Angeles County as a whole, and 16 new businesses have appeared on the by-passed boulevards.

And what of the effect on the tax base of the community? The investment in the new freeway-oriented Sears Roebuck Center in El Monte represents, in a single development, over *twice* the total amount spent for the entire freeway right-of-way through that city.

In short, predictions of a severed and despoiled community have proven completely wrong in El Monte as they have in so many other cases.

Rapid Transit vs. Freeways

Although doing an amazingly good job, freeways are neither perfect nor the complete answer to all transportation problems. Driving them as we do in Los Angeles, either regularly or occasionally, we become familiar with the freeways' capabilities and their limitations. However, it must be remembered that the system is incomplete and that the few, existing freeways are called upon to carry a tremendous overload of traffic which eventually will be distributed on new links of the system. Forgetting this point leads to unfair exaggeration of freeway problems.

On the other hand, what chance has the average Los Angeles citizen to evaluate fairly the potential of rapid transit — particularly in this area? Some may be intrigued by the imaginative picture of a shiny monorail train, gliding smoothly and noiselessly along at 70 MPH, others by the thought of how much more pleasant the freeway might be if the man in the car ahead and the one behind had left their cars at home and been able to ride the monorail instead. But our evaluation must be better than this.

Some very worthwhile data gathering has been done by consultants to the Los Angeles MTA in efforts to evaluate the transit potential and develop a transit program, but the studies have been primarily exploratory and so far inconclusive. The LAMTA has recently received recom-

—California Division of Highways

Figure 4—Harbor Freeway looking north. Note the concurrent development which has taken place on Broadway to the right of the freeway, i. e. left turn channels at the streets which cross, or connect with the freeway.

mendations in response to the following three questions:

1. What shall be build?
2. Where shall we build it?
3. How much will it cost?

The consultants recommended a semi-conventional overhead rapid transit system of 75 miles initial length at cost of $529,000,000.

The most important question of all, "How do we pay for it?" still remains to be studied. Also no study so far shows that there is actually a need for rail-rapid transit, or what patronage might be expected.

Some politicians, public officials, and more extreme transit advocates haven't the patience for these logical but time-consuming studies, and I doubt that this group is very happy with either the recent recommendation for a more practical system in lieu of the popular monorail or the honest $7,000,000 per mile cost estimate. Feeling that they already have the answers, these "experts" continue to distort the picture with a variety of assumptions, opinions, half-truths, and just plain false statements.

Downtown

As an example, sweeping claims are made that rapid transit will relieve congestion on the freeways, solve the smog problem, and prove to be the sole method of survival for the downtown area—rapid transit will save downtown from the inevitable stagnation and decay which accompanies automobiles and freeways. And, more colorfully, such downtowns without transit will "disappear under a layer of concrete."

Now look for a moment at downtown Los Angeles which is largely dependent on freeways. Freeways, adequate to serve the Los Angeles downtown area, are either already built or in various stages of development, and, contrary to the prophets of doom, we find Los Angeles actively planning, building and redeveloping with the freeways in mind. A great, new Civic Center is emerging, the extensive Bunker Hill redevelopment project is moving along, and half a dozen new large office building have been constructed within the last four years. Changes in land use are occurring in downtown Los Angeles; retail trade, for instance, is becoming relatively less important as headquarters functions become more important, but downtown Los Angeles is neither stagnating nor being wiped out by the freeways.

Parking

And what about parking? Actually enough parking capacity exists in the Central Business District of Los Angeles for all the vehicles desiring to park there. True, some of this parking capacity is not well located and more parking demand will come in the future. Adjustments are necessary and the erection of additional parking garages must be considered. While this problem deserves greater attention it need not be viewed with alarm, and certainly is not impossible of solution.

"Approaching Choas"

The advocate may also state that rapid transit is essential to a well-planned city and will prove to be the only alternative to "approaching chaos" in commuter travel—more of the scare approach. Actually, despite tremendous growth, we're traveling better in this area than ever before, and existing transportation planning for the future is more comprehensive than ever before. There is simply no basis for the prediction of approaching chaos, but it seems ever-popular. A brief quote from a report advocating rapid transit will illustrate this timeless popularity:

> "The future orderly development of Los Angeles requires the construction of rapid transit lines . . ." and "If the City's unequalled position . . . is to be maintained it must continue to spread and this spreading can be accomplished only by providing rapid transportation. . ."

In other words, if Los Angeles is ever going to amount to anything and avert chaos it will have to have rapid transit.

Is this a statement of one of today's transit extremists? No, the quotations are from the report "Comprehensive Rapid Transit Plan for the City and County of Los Angeles" dated 1925! Somehow Los Angeles has not only survived 35 years of "approaching chaos" but has grown, without the aid of rapid transit, from the 10th largest city in 1920 to the second largest metropolitan area in the country today.

How Rapid?

Unrealistically high speeds are often claimed for rapid transit—usually the highest speed attainable. Less frequently, the more meaningful average speed from station to station is admitted to, as in the current LAMTA report, but never yet have I heard a

transit expert discuss publicly the actual *total* time required for a rider to get from his home to his place of work. This is the time that really counts and it includes getting to the station, traveling on the transit system, making all the station stops, probably transferring and finally getting from the downtown station to the office. No transit rider will begin and end his trip on the rapid transit line.

Unrealistically High Efficiency

Almost invariably the advocate will imply unrealistically high efficiency for rapid transit in terms of 30 or 40,000 persons per hour capacity. This sounds impressive, but easily overlooked is the fact that to fill this capacity 30 or 40,000 people must be found moving from one spot to another along a transit line in just one hour, whose trips can be served practically by transit. The vast, low density Los Angeles area in which we travel in so many different directions, at so many different times, and for so many different purposes, simply does not produce the type of high concentration of people moving from one point to another that can be served by rapid transit in some cities. Flexible transportation, on the other hand, is admirably suited to serving this Los Angeles dispersion.

Unrealistically Low Cost

It is also important that various rapid transit cost figures be carefully appraised. Such costs may exclude important items such as right-of-way, need for double track, stations, rolling stock, signaling and dispatching, yards and shops, and even operating and maintenance costs. The honest transit advocate will admit that the chances of creating a self-supporting rapid-transit system in Los Angeles are practically nil.

Other "Successes"

Finally, rapid transit proponents often refer to selected examples of alleged successes elsewhere. On a recent trip east, I had the opportunity to evaluate one of these widely heralded transit "successes"—the Highland Branch of the Boston MTA. This has been referred to in national magazines as "a huge success," "the triumph of planning," "modern rapid transit," and as "high speed service."

I rode this "modern rapid transit" in the morning peak hour and found uncomfortable cars, with 50% strap-

—California Division of Highways

Figure 5—Golden State Freeway looking north. Western Ave. interchange right center. Alameda Ave. inter. and construction through Burbank left background.

hangers, operating at an average speed of 18 MPH. It took 38 minutes for the 12-mile ride from Riverside Station to downtown Boston, and this did not include travel time from home to station, or station to office.

This rapid transit operation had every opportunity for success. Using an existing completely grade separated railroad right-of-way, its construction cost was at a minimum. It has a 2,000 car parking lot at the outer end served by a freeway, and connects with the existing subway system of Boston.

—California Division of Highways

Figure 6—San Diego Freeway-Sunset Boulevard Interchange. UCLA campus in left background. Note also new motel construction in foreground.

—California Division of Highways

Figure 7—Looking southeast on Santa Ana Freeway at interchange with Long Beach Freeway.

There are no competing Freeways and Bostonians are conditioned to transit riding.

However, in contrast with the glowing phrases contained in the national magazines a quote from the October 11th edition of the Boston Herald reads as follows:

> "Substantial financial losses by the MTA's highly touted Highland Branch linking Boston, Brookline and Newton, threaten to add upward of $300,000 to the line's already staggering deficit . . ."

(Incidentally, all transit in Boston is heavily subsidized.)

> "The biggest disappointment has been the failure of the Riverside Terminal with its tremendous parking facility and its nearness to . . . the Massachusetts Turnpike to generate the patronage the MTA counted on."

> "The argument was that commuters and shoppers alike would respond to the offer of clean, safe, speedy, and regular service to Boston for a bargain 20¢ fare."

The facts show that the commuters and shoppers just didn't respond. So in Boston we can see a rapid transit operation, which appeared to have many reasons for success, failing to make the grade. What then are the chances of success in Los Angeles?

This example serves two purposes—first, it proves that the prediction of success for a rapid transit venture can be entirely wrong, even under relatively favorable conditions. Equally important to those in other cities, it raises the question of just how much pro-rapid transit material can be accepted after finding such an obvious case of misleading information.

Future of the Freeways

Now, before trying to summarize, we should take just a brief look into the future of the freeways. In 1959 the Legislature adopted a master plan of expressways and freeways for the entire State of California. So, for the first time, this state has a comprehensive plan which gives us a reasonable concept of how the overall freeway system may be built.

In conjunction with the master plan, a study of economic feasibility was made which shows that the future freeways can be constructed within a reasonable time on the basis of existing rates of highway user taxes. In other words, this transportation plan is no pipe dream and will continue to pay its own way as it has in the past. The Federal Interstate Highway Program also is bringing completion of our freeway plan closer.

Thus, we can look with confidence to the future and accept the projections of doubling of population and motor vehicle registration with assurance that, provided we make no ill-advised change, we will see even greater advances in our mobility in future years.

Contrary to the self-appointed experts, there is no do-or-die situation at hand which calls for immediate drastic action. The false prophets of doom, the "inevitable chaos" and "layer of concrete" philosophers should be the last ones to guide us toward intelligent transportation decisions.

Summary

By way of summary the following brief statements are offered:

1. Los Angeles, in its period of tremendous growth, has been served largely by motor vehicle transportation.

2. The freeways which have become the primary key to mobility of our motor vehicle transportation system are presently doing an amazingly good job of moving tremendous volumes of people and goods.

3. Future growth of this area can, and should, be considered calmly, rationally, and optimistically. There is no reason for hysteria, "scare" tactics, or radical changes in emphasis regarding transportation.

4. Almost all are in favor of a balanced transportation system—an atmosphere should be created within which public transportation potential may be optimized. It does not, however, follow that this means we presently have a badly unbalanced system.

5. The assertion that every large urban area must ultimately turn to *rail rapid* transit for the solution of its public transportation problems is certainly subject to question. A very good case can be made supporting the concept of flexible rubber-tired public transportation, utilizing the freeways for express runs.

6. Finally—and most important—intelligent decisions regarding transportation problems can be made only on the basis of an honest appraisal of the present situation, coupled with equally objective analysis and comparison of the alternate courses which we might follow in the future.

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Traffic News

ITE Elects Officers For 1961; Malo Named President

A. F. Malo, director of Detroit's Department of Streets and Traffic, was elected president of the Institute of Traffic Engineers at the 30th annual meeting of the organization held in Chicago September 12-15, 1960.

Gordon K. Gravelle, deputy commissioner of the New York City Department of Traffic, and Robert A. Burch, state traffic engineer of North Carolina, were elected vice presidents at the meeting.

Selected secretary-treasurer in the only contested phase of the election was J. Al Head, assistant state traffic engineer of Oregon.

Also chosen as members of the Institute's Board of Direction were: A. L. Hutchison, assistant general manager of the Los Angeles Department of Traffic; Fenton G. Jordan, city traffic engineer of Norfolk, Virginia; and Herbert B. Woodling, city traffic engineer of Akron, Ohio.

Other members of the Board of Direction, carried over from last year, are: Fred W. Hurd, director of the Yale University Bureau of Highway Traffic, New Haven, Conn.; O. K. Normann, deputy assistant commissioner for research, U. S. Bureau of Public Roads, Washington, D. C.; and Evan E. Olmstead, traffic engineer of the Chicago Transit Authority.

Last year's president, Edward G. Wetzel, special assistant to the director of port development of the Port of New York Authority, remains on the Board of Direction in his capacity as immediate past president.

Terms of the officers are for one year, while the three directors chosen will serve for two years.

Because of the time element, it is impossible to give a full account of the 30th Annual Meeting in this issue. Reports will appear in forthcoming issues of the magazine.

Pinnell Receives Past Presidents' Award For 1960

Charles Pinnell (Junior Mem., ITE) was announced as winner of the 1960 Past Presidents' Award at the Annual Meeting of the Institute of Traffic Engineers held in Chicago in September. His award-winning paper was entitled, "Driver Requirements in Freeway Entrance Ramp Design." The paper will be published in an early issue of *Traffic Engineering* magazine.

Charles Pinnell

Mr. Pinnell is Assistant Research Engineer at the Texas Transportation Institute at Texas A. and M. College, where he has been since 1958. Earlier he worked for the Texas Highway Department and taught at Texas Technological College for four years.

He is a civil engineering graduate of Texas Tech and received his M.S. in C.E. from Purdue in 1958 after graduate work at the University of California and Purdue on an Automotive Safety Foundation grant-in-aid.

In addition to his membership in the Institute, he is an Associate Member of ASCE and of Sigma Xi, and is a registered professional engineer in Texas.

Judges of the competition for 1960 were a committee of past presidents of the Institute of Traffic Engineers. Chairman was M. C. Sielski, Immediate Past President, and serving with him were F. Bruce Crandall, Burton W. Marsh, J. C. McMonagle and Donald M. McNeil. Competition was open to all Junior Members and Associate Members under 35 years of age who submitted a paper reporting original research work in traffic engineering.

Three Papers Receive Honorable Mention in Award Competition

Three papers were voted honorable mention in the 1960 Past Presidents' Award competition of the Institute of Traffic Engineers. These were in addition to the winning paper, submitted by Charles Pinnell.

The honorable mention papers were submitted by: Adolf D. May, Jr., Thompson-Ramo-Wooldridge, Canoga Park, California; Joseph C. Oppenlander, University of Illinois, Urbana, Illinois; Henry D. Quinby, Parsons, Brinckerhoff, Quade and Douglas, San Francisco, California.

May's paper was entitled, "Traffic Characteristics and Phenomena on High Density Controlled Access Facilities." Oppenlander wrote on "A Theory on Vehicular Speed Regulation." Quinby's paper was titled, "Traffic Distribution Forecasts—Highway and Transit." It is expected that all three papers will be published in *Traffic Engineering* magazine in the next few months.

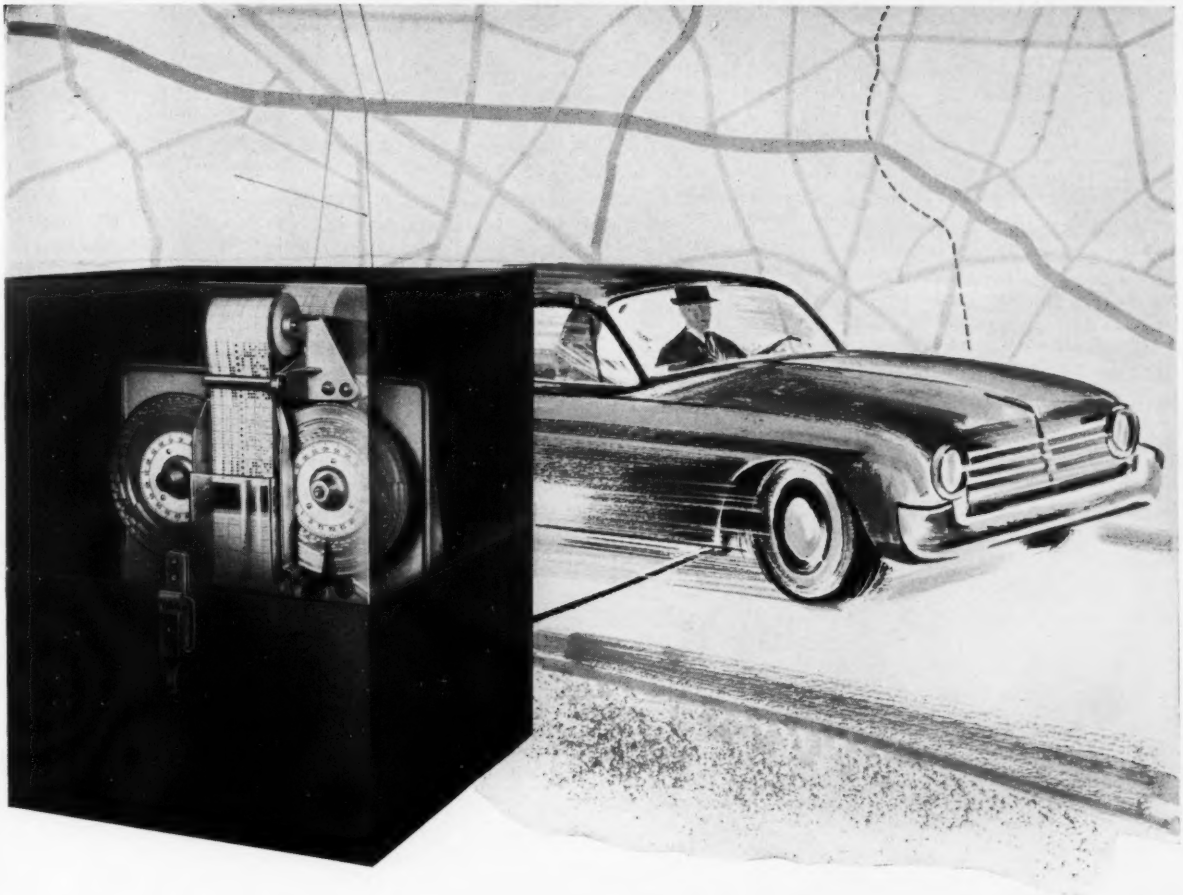
World Traffic Engineering Conference Scheduled for 1961

A World Traffic Engineering Conference is to be held in Washington in August 1961, it was announced at the September 1960 meeting of the Institute in Chicago. The announcement was made simultaneously by the Joint Committee on International Weeks for Traffic Study in London.

The Conference will combine the 31st Annual Meeting of the Institute of Traffic Engineers and the 6th International Study Week in Traffic Engineering according to the announcement. It will be held during the week of August 21 to August 26, 1961, with the first three days devoted to the Annual Meeting of the Institute, and the next three days assigned to the International phase.

The programs of the two meetings will be integrated, with a large overlapping attendance anticipated. Specific themes tentatively scheduled include discussions of the following:

Objectives in the Development of Metropolitan Areas; Urban Transportation and Its Future; Traffic Engineering Research and Its Promotion by International Cooperation; Design of Rural Freeway Interchanges; Highway



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Traffic Accident Research; Electronics in Traffic Control; Freeway Traffic Operations and Control.

Speakers will be chosen on an international basis, to provide the best and widest coverage of the subjects. An opportunity will be provided in each session for a full discussion by all groups represented.

Following the week in Washington, a tour is planned for the foreign visitors to enable them to see at first-hand some of the results of U. S. traffic engineering work. The tentative itinerary includes, besides the Nation's capital, Baltimore, Philadelphia, Trenton, New York City and New Haven together with the highways linking these cities.

Attendance by approximately 100 European representatives is anticipated, together with delegates from all parts of the Western Hemisphere as well as other parts of the world. It is anticipated that a recent extension of the 1958 agreement with Russia for the exchange of scientific personnel will bring representation from that country. All traffic engineers in the world will be welcome, and a total attendance of nearly 1,000 persons is expected, with the greatest number from the U. S. and Canada.

The Institute of Traffic Engineers is a professional engineering society, founded in 1930, and now including more than 1,300 members, of which number more than 100 are outside the U. S. It is devoted to the task of making the most efficient use of streets and highways for purposes of transportation through application of engineering principles involving planning, design and operations. The Washington meeting will be the thirty-first annual gathering of the society.

The Joint Committee on International Weeks for Traffic Study is composed of representatives of three organizations: the World Touring and Automobile Organization, the Permanent International Association of Road Congresses, and the International Road Federation. It has sponsored five Traffic Study Weeks in Europe, the latest in Nice, France, during the week of September 19, 1960. The Washington meeting will serve as the sixth in the series.

The London contact is M. H. Perlowski, the Secretary of the Joint Committee, whose address is World Touring and Automobile Organization, 32 Chesham Place, London S. W. 1, England. The Washington contact is David M. Baldwin, Executive Secretary of the Institute of Traffic Engineers, 2029 K Street, N.W., Washington 6, D. C.

BPR Will Maintain Federal Driver Register

Secretary of Commerce Frederick H. Mueller today designated the Bureau of Public Roads, under the direction of Federal Highway Administrator Bertram D. Tallamy, to establish and maintain the Driver Register authorized by Congress in Public Law 86-660, which was approved by President Eisenhower on July 14. The Register will serve as a clearing house to identify for the states those motor-vehicle drivers whose licenses have been revoked because of driving while intoxicated or conviction of a traffic violation resulting in loss of life.

Secretary Mueller emphasized that the Federal Government is not entering either the driver-licensing or traffic-law-enforcement fields. By terms of the enabling legislation, the Register will be operated as a voluntary State-Federal enterprise. Those states that participate will furnish the Bureau of Public Roads with identifying information on drivers whose licenses are being revoked for the specified causes, and may request the Bureau to check new license applicants against the Register for a record of previous revocation.

Because the program is an innovation, a great deal of exploratory work must be accomplished before the Register can become a working reality. Preliminary forecasts indicate that a pilot operation may be started in mid-1961, and the Register could be in full operation a few months later, according to the Department of Commerce.

—Seattle Times Photo

Seattle Mayor Gordon Clinton (r.) receives the ITE award from Rex G. Still, Washington State Traffic Engineer, at recent award ceremonies at the Washington Athletic Club in Seattle.

International Conference On Road Research

Delegates from thirteen member and associated countries of the Organization for European Economic Co-operation have recommended that an international body should be set up to foster road safety research. This was the major decision taken at a four-day international meeting at the U. K. Road Research Laboratory of D.S.I.R. at Langley, Buckinghamshire.

It is suggested that the international body should be responsible for co-ordinating the research effort of the various countries concerned; to foster the interchange of road research information; and to recommend new researches on problems whose solution requires or would profit from international co-operation.

Sir William Glanville, C. B., C.B.E., F.R.S., U.K. Director of Road Research, was Chairman throughout the meeting, which was held under the auspices of the European Productivity

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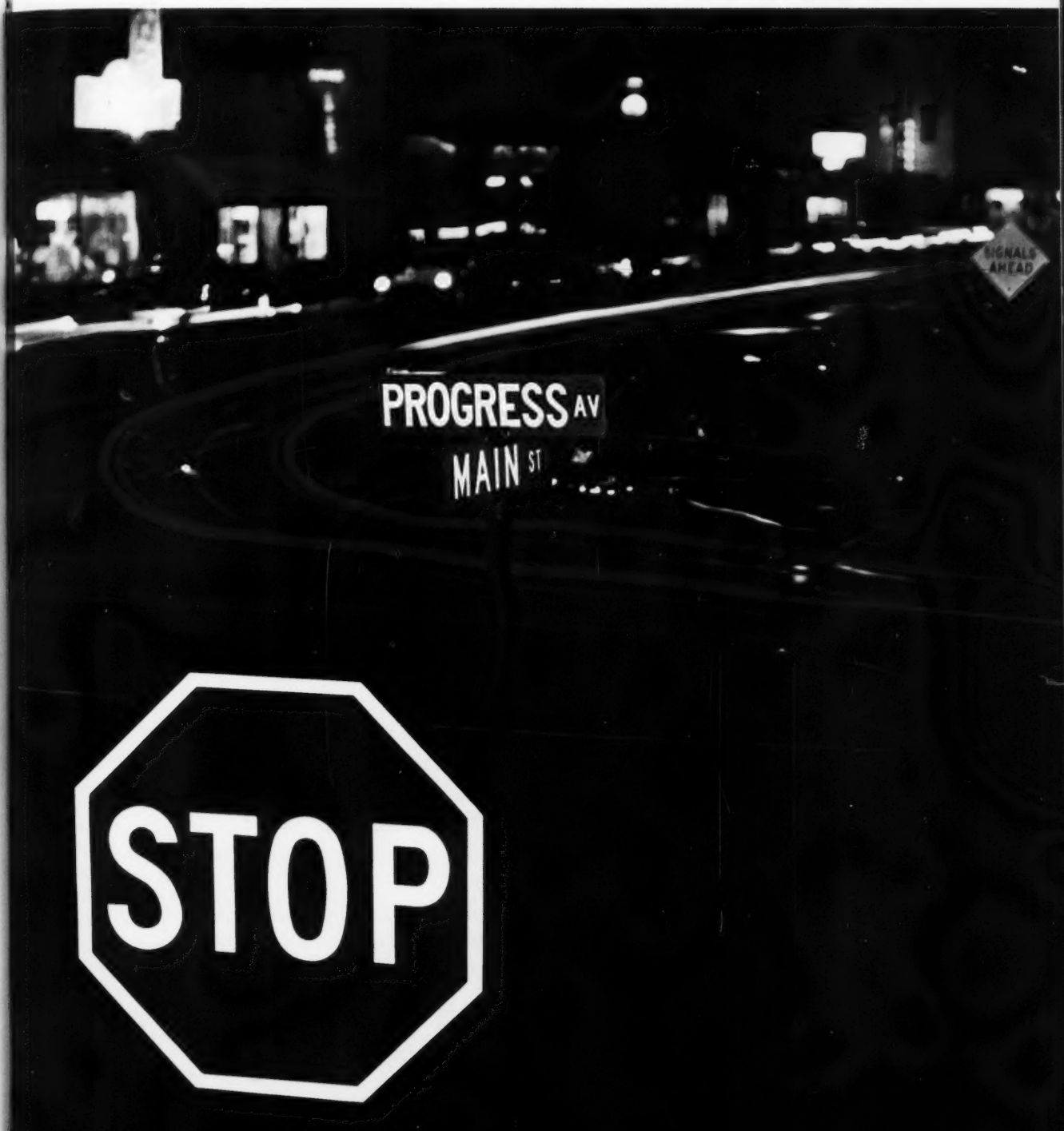

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Agency of O.E.E.C. The countries represented, in addition to the United Kingdom and the United States, were Austria, Belgium, Denmark, Spain, France, Greece, Italy, Norway, the Netherlands, Sweden and Switzerland.

The meeting also recommended that each country should set up a national committee for road safety research which would, additionally, provide a link with the proposed international body.

A consultative Panel of Experts will be formed to consider the steps necessary to carry out these two important recommendations, and a further international meeting is recommended to be called within twelve months to consider progress.

Sir William Glanville stressed the need for closer international co-operation in road research. He pointed out that there already existed a number of broadly based international organizations responsible for the discussion of road safety in the wide sense. The new body would work in close co-operation with these.

"But we are concerned with RESEARCH—with the advancement of knowledge," he said, emphasizing that a new international research body would NOT take over the work of the other organizations.

Without attempting to cover the whole field, the meeting discussed a number of research projects which would benefit from international co-operation. Several of these were already being investigated, some at Laboratories abroad and some at the D.S.I.R.'s Road Research Laboratory, but much more co-ordination of effort was thought desirable. Examples are: (1) The priority rules for vehicles meeting at intersections; (2) Other aspects of road user behaviour, such as where pedestrians cross the road, and the care they take before doing so; (3) Road furniture (lamp standards, sign posts), kerbs, etc.; (4) The comparison of the results of accident investigation teams in various countries; (5) The examination of accident data on the effectiveness of seat belts and harnesses, and similar information on helmets for motorcyclists; (6) The studying of the effects of speed limits on accidents, particularly in towns; (7) The study of the effect of alcohol and drugs.

Underwater Transit Tube To Be Built

Engineering plans for an earthquake-proof underwater rapid transit tube to span the Bay between San Francisco and Oakland have been released.

The tube will be the longest of its type anywhere in the world. Measuring four miles in length, it will serve as a key link in the proposed 100-mile rail rapid transit system now being designed for the Bay region.

Construction of the tube, plus nearly two miles of approaches, will cost $127,191,000, according to consulting engineers for the five-county Bay Area Rapid Transit District. The money already has been authorized by the California Legislature, to be taken from surplus automobile tolls collected on the Bay Bridge.

The engineers said planning of the tube involved the most exhaustive tests ever conducted on the effects of earthquake action. Participating in the studies were several of the world's leading seismologists. There is no question, they said, that the transbay tube can withstand any conceivable earthquake.

The tube will stretch from a point directly beneath the San Francisco Ferry Building to an eastern portal to be located on the Oakland Mole. It will pass under the Bay Bridge midway between San Francisco and Yerba Buena Island. At its lowest point the tube will rest 110 feet below the surface of the water.

Construction of the tube will make it possible for transit patrons to travel from downtown Oakland to downtown San Francisco in less than 11 minutes, as compared with a present peak-hour travel time of more than 40 minutes, the District said.

The tube will be built from prefabricated steel and concrete sections, which can be floated into position and lowered to the bottom of the Bay.

It will take 62 such sections to span the Bay, each measuring 300 feet in length. The tube will measure 35 feet in diameter, except for two specific locations midway in the Bay where wider sections will be needed to house electric power substations.

Electric trains with top speeds of up to 80 miles an hour will travel through the tube directly into double-level subways located beneath Market Street in San Francisco and Broadway in Oak-

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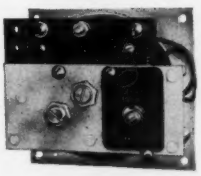

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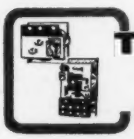

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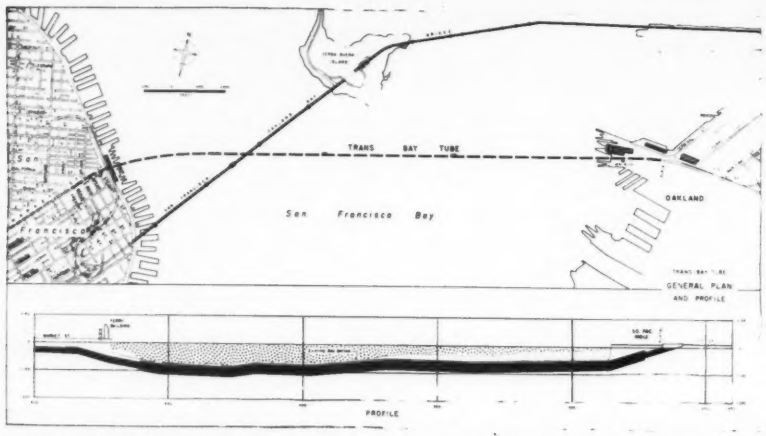


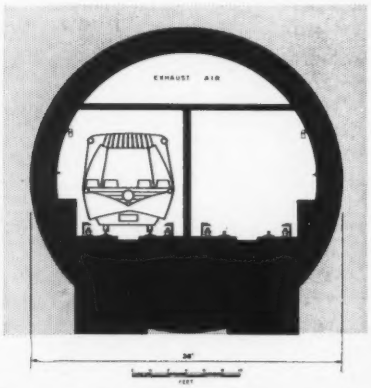
Above illustration shows proposed route for the 4-mile long underwater rapid transit tube which will be built between San Francisco and Oakland. The tube, estimated to cost $127,000,000, will rest at a maximum depth of 110 feet below the surface of San Francisco Bay.

land. From there transit patrons can ride escalators to the street level above.

Engineers for Parsons Brinckerhoff-Tudor-Bechtel, the joint group of consultants employed by the District, said construction of the tube will in no way cause damage to San Francisco's Ferry Building, which is noted for having survived the historic 1906 Earthquake.

To connect the tube with the Market Street subway, builders will tunnel 70 feet beneath the Ferry Building. A "cut and cover" type of construction will be used at the Oakland side of the Bay.

Individual tube sections can be fabricated at various Bay Area shipyards and drydocks, the engineers said. Each will be made from welded steel plates attached and reinforced with circular steel rings and concrete. Before being floated out to the site, the sections will be completely sealed at each end. Later, after they have been welded together on the bottom of the Bay, these bulkheads can be removed. The entire tube will be assembled in a shallow ditch dredged out on the floor of the Bay. Mud and sand will be placed back over the tube to give it added weight and stability.



Above illustration shows cross-section of the proposed underwater rapid transit tube which has been engineered for the San Francisco Bay Area. The tube will span the 4-mile distance between San Francisco and the City of Oakland.

County Officials Elect Alabaman As President

Dan W. Gray, chairman of the Board of the Calhoun County Commission (Anniston, Alabama), was elected President of the National Association of County Officials at the NACO Conference in Miami Beach in August.

The 53-year old Alabaman, serving his tenth consecutive year as a County Board Chairman, succeeds William E. Dennison, of Vernon, Michigan as head of the 8,500-member national organization which represents county leaders and county governments in 47 states.

A member of the Anniston Rotary Club, former Chamber of Commerce President, and American Legion Post Commander, Mr. Gray upon assuming his new position today pledged a continuation of NACO's hardhitting program aimed at improving the administration of county government throughout the nation and to work for stronger leadership by counties in solving the many local problems confronting the nation today.

His election ended the four-day meeting in which the county officials tackled a wide range of problems from air pollution to medical care for the aged, and heard a succession of nationally known speakers.

"It may be said as a universal rule that a government which attempts more than it ought will perform less."

—Lord Macaulay

—Miami-Metro News Bureau Photo

MIAMI BEACH, Fla.—Left to right, Dan W. Gray, chairman of the Board of Commissioners, Calhoun County, Alabama and newly elected President of the National Association of County Officials; Sen. Estes Kefauver, Tennessee Democrat, William E. Dennison of Vernon, Michigan, outgoing president of NACO; and Sen. Thruston B. Morton, chairman of the Republican party, chat following the senators' speeches at the second general session of the Silver Anniversary Conference of NACO at the Fontainebleau Hotel Aug. 14-17.

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New Publications

Highway Research Board Publications of Interest to Traffic Engineers

BULLETIN

235. Traffic Behavior on Freeways. (1960) Pub. 698. 132 p., $2.40.

237. Highway Laws, 1959. (1960) Pub. 700, 29 p., $0.60.

240. Highway Accident Studies. (1960) Pub. 726, 56 p., $1.00.

244. Effects of Traffic Control Devices. (1960) Pub. 730, 97 p., $1.80.

247. Sign Supports: Foundation Design. (1960) Pub. 733, 35 p., $0.80.

249. Highway Needs and Programming Priorities. (1960) Pub. 738, 75 p., $1.80.

252. Snow and Ice Control with Chemicals and Abrasives. Contains the following reports: *Chemical Mixture Test Program in Snow and Ice Control,* by C. H. Lang, Chief Engineer, New York State Thruway Authority; and W. E. Dickinson, Chief Engineer, Calcium Chloride Institute. Description of results and cost advantages realized on experimental tests of calcium chloride with rock salt and with abrasives on the New York Thruway. *Use of Chemicals and Abrasives in Snow and Ice Removal from Highways,* by D. R. Brohm, Maintenance Section, Ontario Department of Highways; and H. M. Edwards, Professor of Civil Engineering, Queen's University. Results of laboratory tests to determine the effectiveness of various mixtures as ice and snow melting agents. $.80.

SPECIAL REPORT

52. A Framework for Urban Studies: An Analysis of Urban-Metropolitan Development and Research Needs. (1960) Pub. 722, 29 p., $1.20.

53. State Highway Organization Charts, 1959 Revised. (1960) Pub. 723, 50 p., $1.60.

55. Highway Research in the United States. (1960) Pub. 736, 119 p., $2.80.

OTHER SERIES

Highway Research Board Publication Index 1956-1959. (1960) 129 p., $2.60.

Roadside Development, 1960. (1960) 25 p., $1.00.

(Checks or money orders may be made payable to "Highway Research Board" or to "National Academy of Sciences.") Address orders to: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington 25, D. C.

New Appointments

Butcher Appointed Manager of Montgomery County, Md.

Mason A. Butcher (Mem., ITE) has been named County Manager of Montgomery County, Maryland. He takes over from Melvin L. Reese, recently appointed City Manager of Miami, having been acting manager since Reese's resignation several months ago.

Mr. Butcher has been employed by Montgomery County since 1950, when he was appointed the first traffic engineer of the county. Two years later he was named Director of Public Works for the county, a position he held until his new appointment. On two previous occasions he served as acting manager, but not until this year was he a candidate for the manager's position.

A native of Nebraska, Butcher graduated from the University of Nebraska in 1936 and went to work for the Nebraska Department of Roads and Irrigation, eventually becoming assistant traffic engineer and later State Airport Engineer. During the war he served as an airborne electronics officer on a carrier. In 1949 he came to Washington as traffic engineer with the Capital Transit Company.

Mr. Butcher completed the Yale Bureau course in 1940, and is a registered professional engineer. He has been active in the Washington (D. C.) Section of the Institute, and is a member of the Maryland Society of Professional Engineers.

Langsner Becomes Assistant State Highway Engineer

George Langsner (Associate Member, ITE) has been promoted to Assistant State Highway Engineer by the California Division of Highways. He had been Engineer of Design for the Division.

The change was part of a major regrouping of headquarters engineering and administrative functions, which included the appointment of a third Deputy State Highway Engineer. In his new position, Mr. Langsner will report to one of the three Deputy State Highway Engineers and will oversee the functions of Office Engineer, Federal Secondary Roads, City and Cooperative Projects, and Service and Supply and Management Analysis.

Mr. Langsner joined the Division of Highways in 1931 upon graduation from the California Institute of Technology. He served in the Los Angeles district (District VII) in positions of increasing responsibility, including design and other work in planning the Los Angeles metropolitan area freeway system, and became District Engineer there in 1955. He was transferred to Sacramento headquarters office in 1957 as Engineer of Design. He is currently chairman of the Committee on Design of the American Association of State Highway Officials.

He is a native of Brooklyn, New York, coming to California in 1922.

Streb to Port of New York Authority

Paul L. Streb (Assoc. Mem. ITE), has joined the staff of the Port of New York Authority.

Paul L. Streb

Since 1955 Mr. Streb has been Assistant Traffic Engineer with the Rhode Island Department of Public Works.

A civil engineering graduate of Villanova University, Mr. Streb received a fellowship to the Yale Bureau of Highway Traffic and graduated in June 1955. He is a registered professional engineer in New York and Rhode Island.

He will work in the traffic control and operations section of the Port Authority.

Job Changes

Mason A. Butcher—formerly Director of Montgomery County Department of Public Works in Rockville, Maryland; is now the County Manager of Montgomery County.

Richard A. Conley—formerly Assistant Director in charge of Public Works for the City of San Antonio, Texas; is now Assistant Director of the Department of Traffic and Transportation for the City of Houston, Texas.

Gerald H. Frieling—formerly an Associate with Wilbur Smith & Associates in Kansas City, Missouri; is now Manager of the Downtown Committee of Kansas City, Missouri.

Paul L. Streb—formerly Assistant Traffic Engineer with the Department of Public Works in Providence, Rhode Island; is now Traffic Engineer with the Port of New York Authority in New York City.

Title Changes

Louis A. Andriacchi—is now Division Sales Manager of Minnesota Mining & Manufacturing Co. in Newton Center, Massachusetts; was Market Manager in St. Paul, Minn.

Alan T. Gonseth—is now Staff Engineer in the Research Section of the Project & Planning Division, Tunnels & Bridges Department of the Port of New York Authority in New York City; was Research Technician.

Vealess F. Hudspeth—is now Assistant Traffic Engineer with the Traffic Operation Section of the Colorado Department of Highways in Denver, Colorado; was an Associate Engineer.

George Langsner—is now Assistant State Highway Engineer—Administration, with the California Division of Highways in Sacramento; was Engineer of Design.

William R. Marston—is now Assistant Commissioner, Department of Streets and Sanitation for the City of Chicago, Illinois; was City Traffic Engineer.

John F. May—is now Assistant Traffic Engineer with the Illinois Division of Highways in Springfield; was Civil Engineer III.

Martin Wohl—is now Assistant Professor of Transportation Engineering in the Civil Engineering Department of Massachusetts Institute of Technology; was Instructor.

J. C. Young—is now Chief Engineer with Porter & O'Brien in Sacramento, California; was Chief Highway Engineer with Porter, Urquhart, McCreary & O'Brien in Salt Lake City, Utah.

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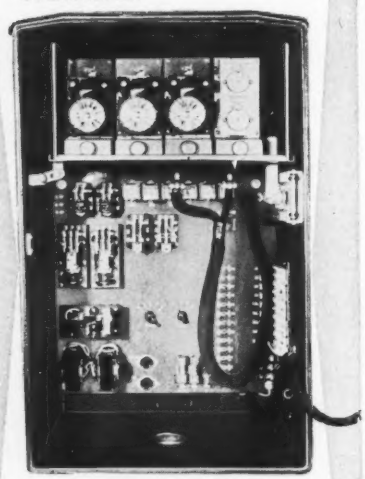

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Minit Park Garage To Open in NYC

New York's tallest and newest garage for Wall St. area of lower Manhattan will get a lift, literally and figuratively, when the ten level Minit Park Garage is opened in December for 210 cars.

This is the first structure to be built under the revised Administrative Code of the City of New York which now permits ten levels (or 75′) in a concrete open-deck facility that automatically lifts cars, carries them into the cab of the elevator and places them in the assigned stalls on their wheels. "Look Ma, no hands!" is strictly true as no one touches a vehicle after the owner leaves and locks it. This assures complete safety for car and contents as well as one-minute receipt and delivery. Two high-speed elevators travel vertically and horizontally with car-handling dollies doing the job with only one man on each elevator.

Minit Park is engineered and built by the Alliance Machine Company of Alliance, Ohio, and is represented exclusively in the United States and Canada by the Minit Park Garage Company, Harold P. Hallock, president.

"The answer to urban parking problems and better business downtown," as Mr. Hallock puts it, "is a vertical solution and this means mechanical handling where choice sites near the generators of demand can be developed into useful capacities." Earlier Minit Park garages were built for the Pennsylvania Railroad and the City of Alliance. This latest version embodies a new dolly lifting all four wheels and will handle all cars down to 4½″ of road clearance, runs at 264 f.p.m. and spots cars precisely in each stall so that after the initial pick-up cars can be parked or unparked automatically as the elevators are self-leveling and side-spotting.

Mr. Hallock points out that while the property was expensive and only a 57′ x 85′ corner, this 210 car garage will be a useful and decorative improvement close to the hub of the financial district where parking is at a premium according to David Rockefeller's Downtown Lower Manhattan Assoc. which is sponsiring a re-birth of activity there.

While mechanical garages can be built as large as the site permits and the demand indicates, Mr. Hallock feels that smaller units do not compound the on-street traffic problem, can be closer to more generators of demand without destroying the continuity of retail trade districts and the sites more readily acquired. Garages

may be built of unprotected steel to 8 levels in New York or 10 levels in concrete precast elements, both of which can be dismantled and re-erected where the end use of the land is for other than garaging.

Infrared Detector Provides Flexibility

An infrared traffic detector designed for in-minutes installation and easy mobility from one location to another to cope with changing traffic patterns has been introduced by the Heiland Division of Minneapolis-Honeywell Regulator Company.

Company engineers said the device —called the Traffitrol Detector—offers wide flexibility to traffic engineers and law enforcement officials in studying and controlling traffic. It can be connected with all types of existing traffic control boxes and central computers to actuate semaphores in accordance wtih traffic flow.

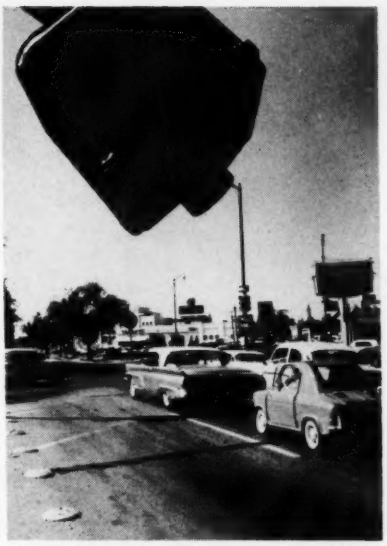
The use of infrared techniques, engineers said, makes the device highly accurate, virtually foolproof, and able to detect and count cars traveling up to 80 miles an hour.

Measuring only 8½ by 8½ by 9 inches and weighing 18 pounds, the detector can be installed without excavating pavement as is required for magnetic or pressure-plate traffic detectors, the company said. Nor is it necessary to build special mast arms of the type employed with critically-positioned radar units.

It was explained that the Traffitrol Detector can be mounted easily on utility poles, sides of buildings or any other convenient locations up to 50 feet from the roadway. It is positioned so that an infrared beam projects downward onto the traffic lane or lanes. The beam is reflected from the pavement back into a receiver lens. When vehicles break the beam, they are detected and counted.

Company engineers said a single lane of traffic can be monitored or the Traffitrol Detector can be positioned to regulate traffic lights on a multi-lane street.

Should existing traffic patterns change, the detector can be removed easily and placed elsewhere. This wide versatility in mounting, the engineers said, makes the detector especially useful for controlling vehicles through detours, during traffic tests or in other temporary situations.



INFRARED EYE—Keeping an eye on traffic at a busy Denver, Colo. intersection is a new infrared traffic detector (top foreground) introduced by Minneapolis-Honeywell's Heiland Division. The Traffitrol Detector provides wide flexibility to traffic engineers in studying and controlling vehicular traffic, Honeywell engineers said. It can be mounted in a few minutes on a utility pole or the side of a building and moved easily to a new location whenever traffic patterns change. The firm's engineers said use of infrared-sensing techniques makes the device virtually foolproof in detecting and counting vehicles, even those traveling up to 80 miles an hour.

The unit will operate on asphalt, concrete, gravel or dirt roadways.

Single units of the Traffitrol Detector may be purchased for $450 for evaluation by traffic engineers. Additional information may be obtained by writing Minneapolis-Honeywell's Heiland Division, 5200 East Evans Avenue, Denver 22, Colorado.

Motorola Awarded Radio Traffic Control Contract

Motorola has been awarded a $135,000 contract to expand the radio traffic control system in Washington, D. C. The contract covers 66 transistorized intersection units. Installation is expected early next year.

The District of Columbia system, which went into operation in September 1959, presently sends radio signals from a Motorola master programming and coding station to over 225 intersections. The new order is the third step in a program to bring all of the city's 1000 signal-controlled intersections under radio control.

Forty-five of the ordered units are receiver-decoders to tie isolated traffic signals or small groups of cable-connected signals into the system. The other 21 are decoders only, which can be installed at cable-connected intersections to provide individual signal control within already joined blocs, now radio-controlled as units.

The intersection units are designed for continuous operation under all climatic conditions. They receive and decode synchronization and function signals from a high speed, high capacity master programmer. Appropriate signal voltages are fed to traffic light controllers at intersections, providing offset synchronization and time cycle changes to coordinate traffic flow. The system operates in the 960 megacycle band.

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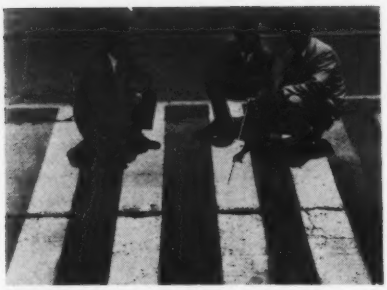


EPOXY STRIPING TESTED—Epoxy paint for street and highway striping is being given its first tests by the Los Angeles City Traffic Department, as well as by a number of other municipalities. Here A. L. Hutchison, right, assistant general manager of the Traffic Department, and R. W. Andrews, left, traffic operations engineer with the Los Angeles County Road Department, join John G. Mattes of Chem Seal Corp., which supplied the epoxy coating, in inspecting white striping originally applied eight months ago on both asphalt (foreground) and concrete (background). More than 4,000,000 vehicles, primarily trucks, are estimated to have passed over the painted area.

Los Angeles Tests Epoxy Coatings

The Los Angeles City Traffic Department is nearing completion of its first tests of epoxy coatings for street and highway striping.

Similar field tests are being set up by the Los Angeles County Road Department and have been conducted by municipalities in Washington, Texas, Oklahoma, New Mexico and New York.

The Los Angeles Traffic Department has regularly tested conventional oil-based paints used in street striping, but only within the past year decided to initiate tests of the new type super-adhesive epoxy paint.

The epoxy coating for the tests is being supplied by Chem Seal Corp. of Los Angeles and is designated as CS 2721 Hiway Stripe. The paint is being tested for color retention, resistance to abrasion, reflectivity, durability and other qualities, the Traffic Department pointed out.

A series of white, red and yellow stripes were painted on a heavily-traveled thoroughfare in the Los Angeles industrial area eight months ago. One half of each test stripe was laid on asphalt pavement and the other half on concrete. An estimated 18,000 vehicles, primarily trucks, have passed over the painted section daily—a total of more than 4,000,000 vehicles since the start of the test.

Three Wald Machines Meet in Kansas

Concentrated in the comparatively small but densely populated area of Kansas City, Mo.; Kansas City, Kansas, and Wyandotte County, Kansas are three Wald Town and County "Push Button" Striping Machines. The other day, through coincidence, they happened to meet on Southwest Boulevard at State Line, and a photographer, not through coincidence, was on hand to picture the unusual event.

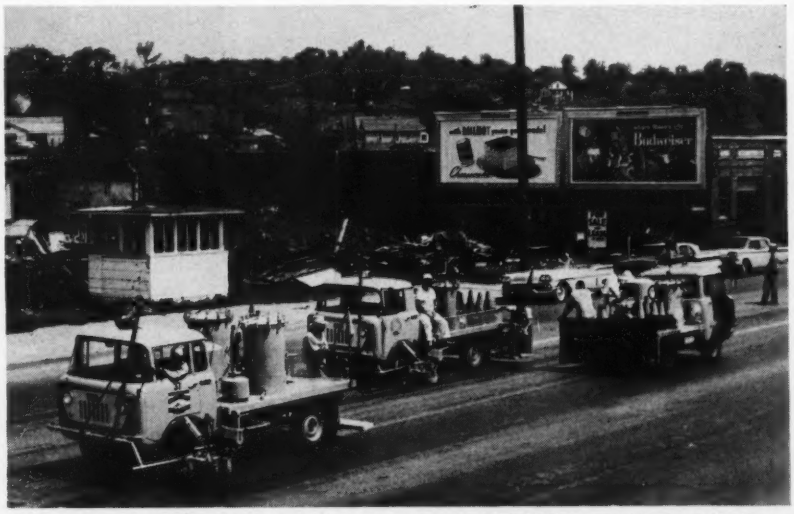
Jim Story, Wyandotte County road engineer, chats with the driver of the county's Wald Town and County striping machine, put into service last spring. Story and his crew agree that the machine "does a real job."

Kansas City, Mo., was the first of the three to purchase a T & C, obtaining it in 1958 to help in carrying forward the tremendous traffic marking program that is the responsibility of O. J. Falin, Director of the Traffic Department and the specific assignment of Jack Hartley, traffic engineer in charge of operations.

Jim Story, road engineer of Wyandotte County, Kansas, bought his T & C in March of 1960 and immediately put it to work striping the 115 miles of county roads in his area.

Most of the county's striping was done previously under contract, and the many townships in the county's 147 square miles still either do their own marking, or have it done by contract. Story anticipates that eventually the county will do all striping, including that of the townships.

"We're probably one of the few



While many state highway departments have more than three Wald Town and County or Statesman striping machines, it is unusual to find three of the modern "push-button" stripers, each owned by a different municipality, operating so close together and each operating in its own bailiwick. The machines are positioned at a point where Kansas City, Kansas, which is in Wyandotte County, Kansas, and Kansas City, Missouri meet—S.W. Boulevard at State Line. The machine on the left is owned by Wyandotte County; center, by Kansas City, Kansas, and right, by Kansas City, Mo.

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- Cycle Selector
- Speed Controller
- Advance Green Timer
- Lagging Green Timer
- Pedestrian Interval Timer
- Volume Computer
- PR System
- Radar Detector
- Minor Movement Controller
- Radar Speed Meter
- Railroad Radar
- Speed Computer
- Traffic Monitor
- Density Computer
- All-Red Clearance Timer
- Phase Overlap Unit
- Plug-In Controllers and Accessories

ELECTRO-MATIC CONTROL — TRAFFIC ACTUATED

AUTOMATIC SIGNAL DIVISION EASTERN INDUSTRIES, INC.
NORWALK, CONNECTICUT

This is the Kansas City, Kansas new Wald Town and County striping machine, purchased last spring, complete with its efficient crew. Traffic Engineer Walter McDaniels, not in the picture, says that with the machine his crew does about twice as much striping in the same length of time as before.

counties in the country that has a machine like this," Story points out, "but it does a real job on our roads, and we like the fact that we can move about from one part of the country to another, without delay, to stripe where necessary."

In Kansas City, Kansas, Traffic Engineer Walter McDaniels has only praise for his T & C. "We do about twice as much striping in the same length of time as we did before we bought it," McDaniels says. "We'll put down about 645 miles of skip and center lines this year, plus repainting 3,280 feet of curbing, 97 crosswalks and 192 crossing lanes."

O. J. Falin, left, director of the Kansas City, Mo., Traffic Engineering Department, and Jack Hartley, traffic engineer in charge of operations, pose with the Wald Town and County striping machine and its crew. The machine has been in use in Kansas City, Mo., since 1958.

G. E. Announces New Bulletin

General Electric has published a bulletin on Preferred Lighting. This bulletin (GEA-1700) is 28 pages and provides layouts, specifications and application data for entire street-lighting systems. Included are footcandle guides for Preferred Lighting Line of filament, mercury, and fluorescent units and product data on lighting units, controls, ballasts, poles and brackets. Well illustrated, the photos show typical street, highway, shopping center and parking area lighting applications. The foreword describes how to select roadway lighting equipment.

The bulletin is available from the General Electric Company, Schenectady 5, N. Y.

Coming Events

October 9-12—AMERICAN TRANSIT ASSOCIATION—
Annual Meeting, Sheraton Hotel, Philadelphia, Penna. Contact: ATA, 355 Lexington Ave., New York, N. Y.

October 9-13—AMERICAN SOCIETY OF CIVIL ENGINEERS—
Annual Convention, Statler Hotel, Boston, Mass. Contact: ASCE, 29 West 39th St., New York, N. Y.

October 15 - 23 — NATIONAL AUTOMOBILE SHOW—
Cobo Hall, Detroit, Michigan.

October 17-21—NATIONAL SAFETY COUNCIL—
National Safety Congress and Exposition, Hilton, Congress and other hotels, Chicago, Ill. Contact: NSC, 425 N. Michigan Avenue, Chicago 11, Ill.

November 28-December 2—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
Annual Meeting, Sheraton-Cadillac Hotel, Detroit, Mich. Contact: AASHO, 917 National Press Bldg., Washington 4, D.C.

January 9-13, 1961 — HIGHWAY RESEARCH BOARD—
Annual Meeting, Sheraton-Park Hotel, Washington, D. C. Contact: HRB, 2101 Constitution Avenue, Washington 25, D.C.

AUGUST 21-26, 1961—WORLD TRAFFIC ENGINEERING CONFERENCE—
31st Annual Meeting, Institute of Traffic Engineers and 6th International Study Week in Traffic Engineering, Sheraton-Park Hotel, Washington, D. C. Contact: ITE, 2029 K St. N.W., Washington 6, D. C.

William R. Welty

William R. Welty (Member, ITE) died July 11 after a long and painful illness. At the time of death he was Supervising Traffic Engineer for the Texas Highway Department, stationed in Austin. He was 48 years old.

Mr. Welty attended the University of Texas from 1929 to 1932, and again in 1943 and 1944, when he received his B.S. in C.E. degree. After early experience with a private engineering firm, he joined the Texas Highway Department staff and worked continuously for the state except for the winter of 1945-46 when he was a student at the Yale Bureau of Highway Traffic. He received his Yale certificate in June 1946 and returned to Texas as an assistant traffic engineer.

He was active in the Texas Section of the Institute, and was a member of the American Society of Civil Engineers and the National Society of Professional Engineers. He was registered in Texas.

Junius H. Payne

Junius H. Payne (Associate Member, ITE) died August 17. He was 70 years old at the time of death, and had been living in Magnolia, Mississippi for the past two and a half years.

Mr. Payne retired in 1958 from the Florida State Road Department, where he had been Assistant Engineer for the Planning and Traffic Division. Altogether he spent 15 years with the Department, nearly 10 years of his time in design.

A civil engineering student at Louisiana State University, Mr. Payne was for many years in private practice. From 1940 to 1943 he worked for the Quartermaster Corps and the Corps of Engineers in Louisiana and Georgia.

Mr. Payne was a registered professional engineer in Georgia.

LATERAL PLACEMENT

(Continued from page 28)

Data Reduction

Before data were transcribed from the instrument record charts, the length of sweep (placement) and the cumulative length of chart at which the impulse occurs (time of occurrence) were noted opposite each impulse directly on the record chart. A second reading of the record charts was required to transcribe the information to data sheets or punch-card forms. The double handling of the instrument record charts proved to be more efficient than any other method of tabulating data from the records.

Following transcription from the instrument record charts to punch cards, the data were analyzed on an IBM 705 computer. The program computed headways, placement, velocities and accepted gaps (in the case of the merging lane) by fifteen minute increments. Frequency distributions, means, percentiles and variances were calculated for the above traffic characteristics at each of the eight placement tapes.

Suggested Improvements

Certain modifications and changes in design are recommended for future use of the instrument system. The placement detector tapes were designed to be exactly ten feet long and to record placement in one-foot increments when placed at right angles to the edge or tangent to the edge of the pavement. 'Cocking' or angling the tapes—to permit the detection of individual wheels

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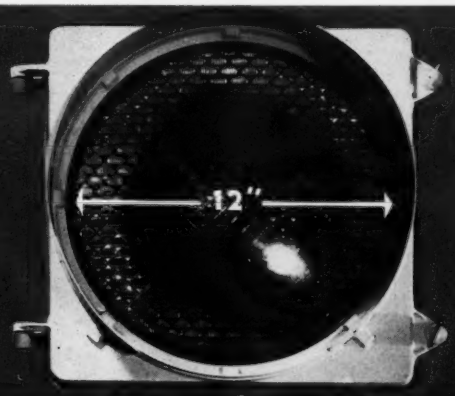

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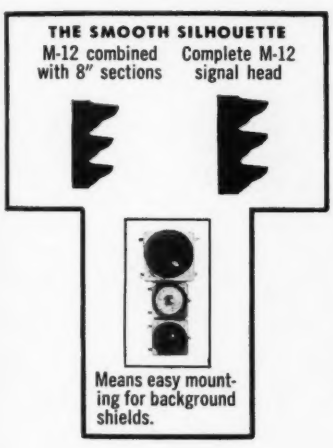

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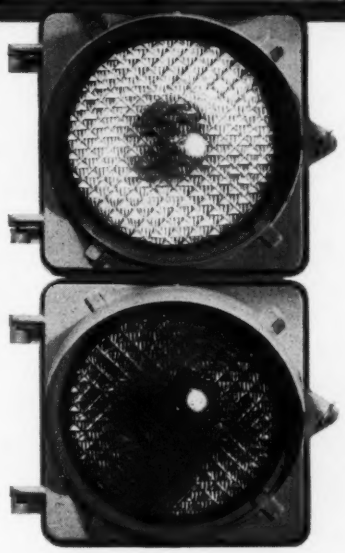

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—(Figure 5) necessitated calculations of placements from the chart record. Compensation for angling in the design of the tapes will permit direct reading of placement. The length of the segmented strips within each tape is equal to the product of the cosecant of the angle between the tape and the tangent to the pavement edge, and the desired lateral distance for each increment. For example if the tapes are to be angled 70° from the tangent to the edge of pavement, (20° from the perpendicular) and placement readings are to be accurate to one foot each segment will be 1.064 feet long and if angled at 60° from the tangent to the edge of pavement each segment will be 1.15 feet long.

Two separate Brush recorders were used in recording data for the eight placement tapes. It was necessary to make adjustments and corrections for the slightest difference in speed of chart feed for the two recorders. Data reduction will be simplified if a single four-channel chart recorder can be used with the system.

Future designs should also include encapsulation of the voltage dividers in electrical insulation resin. This would assure the life of these devices over long periods of service.

Separate calibration of each recorder pen, by a rheostat in series with each pen motor, would also prove helpful. Correction factors occasionally required by differences in the blip magnitudes of the several pens would be eliminated, facilitating more rapid transcription of data from the recorder rolls to data sheets.

The equipment as described is not suitable for use in the rain, nor for prolonged installation for days or weeks in heavy traffic. It is suggested as a convenient instrument system for periodic installation for individual afternoon or evenings where the dominating considerations are number of measuring locations, negligible conspicuity of measuring equipment, capacity for night and day measurements, ease and economy of equipment manufacture, and the permanent re cording of data.

Technical Notes

CONTROL DEVICE FOR BLIND INTERSECTIONS

Adapted by Stephen G. Petersen, from a report of the Iowa State Highway Commission.

In order to overcome a serious problem of restricted sight distance at many lightly traveled intersections the Iowa State Highway Commission is experimenting with a new control device.

Briefly the situation is this. As a result of the older type of construction 25 to 30 years ago on the primary road system, there are many problem intersections with secondary roads where sight distances are restricted along the primary roads for traffic desiring to enter or cross from the secondary road. Reconstruction eliminating the sight distance restriction on the primary road at isolated intersections throughout the state, when no additional work is contemplated on the primary road, would involve a great expenditure of money with very little total improvement for the road. As a result of the considerable expense for improvement of restrictions, consideration was given to research for the development of some type of control device or signalization to provide a warning to traffic on the secondary road of approach traffic conditions on the primary road.

An intersection having a blind condition caused by a vertical curve on the primary road was chosen as the research site. The characteristics of the location are listed in Table I.

As the table shows most of the northbound traffic from the secondary road turns left, thus requiring an uphill acceleration from a stop condition. This has resulted in numerous near accidents although only two have actually occurred in a 7 year period.

The device chosen to overcome the hazardous situation related above was a type of signalization which would be visible only to northbound traffic on the secondary road. The signal warns of primary road traffic approaching from the west at speeds varying from 30 mph to 70 mph and also provides an indication when a safe entry onto the highway can be made in relation to eastbound traffic. As there is no sight restriction to the east of the intersection, drivers of vehicles entering the highway must rely on their own judgment for safe entry in relation to the traffic coming from that direction. The signal installation consists of a twelve inch steady red indication to warn of approaching hidden traffic from the west and an eight inch flashing red indication to show that there is no traffic approaching from the west, but that a stop is required before entering or crossing the primary road. The signal indications are in addition to the "Stop" sign. The figure shows the signal installation along with the appropriate signing to advise northbound drivers of the functions of the signal.

To activate the normally dark 12 inch red indication, a magnetic detector is installed 1100 feet west of the intersection. This distance provides approximately 11 seconds at 70 mph as a time interval for northbound vehicles to enter the highway from a full stop, cross and clear the vehicle detection lane for left turns and straight through movements, or turn right and accelerate downhill in the vehicle detection

TABLE I

CHARACTERISTICS OF STUDY INTERSECTION

Alignment: Horizontal—Straight

Vertical—14′ rise to crest 450′ to west; from crest roadway falls 14′ in similar distance.

Traffic:		Primary road, west approach	Secondary road, south approach
AADT		1400	71
trucks & buses		—	25%
turns, left		—	80%
Speed:	Range	30 MPH to 70 MPH	—
	Average	55 MPH	—
	Statutory	70 MPH Day 60 MPH Night	

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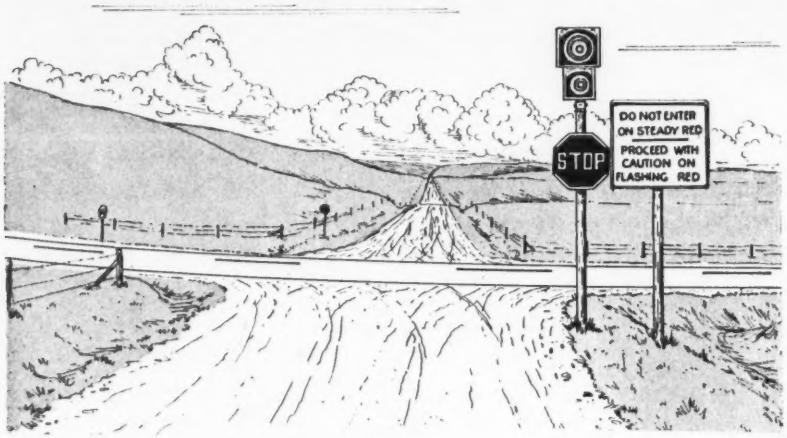

Figure 1

lane. This 11 second interval is adequate for all types of vehicles that enter the highway to make their traffic movement and not be exposed to a hazardous condition that might create an accident. For vehicles of slower speeds on the primary road down to approximately 35 mph, the vehicle interval on the controller is set at 21 seconds and the clearance interval at 1 second to provide holding of the steady red indication a total of 22 seconds to allow the 35 mph vehicle to clear the intersection. Vehicles traveling 30 mph will not hold the steady red indication until they are entirely clear of the intersection but since they are past the crown of the vertical curve and are visible, the driver attempting to enter the highway is controlled by the "Proceed With Caution On Flashing Red" sign and flashing red signal similar to the entry being made in relation to traffic approaching from the east. Successive cars from the west reset the steady red indication through the red delay interval on the controller.

Since passing is prohibited in the vicinity of the magnetic detector false or delayed indications for secondary road traffic are eliminated.

A vehicle approaching the intersection from the south on the secondary road and encountering a change of the signal from flashing red to steady red is held from entering the highway for 22 seconds by one vehicle approaching the intersection from the west. If the vehicle approaches from the west at 70 mph, it will pass the intersection in 11 seconds and restrain the vehicle at the signal from entering the intersection for an additional 11 seconds before the change back to flashing red. If the vehicle from the west approaches at 35 mph the vehicle at the signal is held for 22 seconds, after which time lapse, the signal changes to flashing red and the approaching vehicle has just cleared the intersection. A steady procession of cars, approaching the intersection from the west at time intervals of 22 seconds or less, holds the signal on steady red by resets until a time interval of 23 seconds or more is reached which allows the signal to return to flashing red. As the traffic on the primary road is relatively low and the traffic on the secondary road is much lower in comparison, there are no long intervals of steady red indication for northbound traffic that restrict movement of traffic through the intersection to any great degree.

To date there have been no serious malfunctions. Both the people using the intersection and the Highway Commission feel that the device has overcome the type of hazard peculiar to a situation of this sort.

SIMULATION

(Continued from page 25)

Conway, R. W., et el, "Some Problems of Digital Systems Engineering," *Management Science*, October 1959.

Gerlough, D. L., "A Comparison of Technique for Simulating Flow of Discrete Objects," Paper presented at the National Simulation Conference, October 23-25, 1958, Dallas, Texas.

Gerlough, D. L., "Traffic Inputs for Simulation on a Digital Computer," Highway Research Board Proceedings, 1959.

Goode, H. H. and R. E. Machol, *System Engineering*, McGraw-Hill Co., 1957. Chapters 9 and 10.

The Technical Council

Its Purpose, Membership, Duties, and Activities

The Technical Council is the chief technical authority of the Institute of Traffic Engineers. All technical activity of the Institute falls within the province of the Council, and it therefore becomes the backbone of the organization for matters of traffic engineering techniques or knoweldge.

The government of the Institute is divided into an Administrative Division (dealing with membership, meetings, and similar matters) and a Technical Division. Each is under the supervision of a Vice President, designated for this purpose by the President. The Vice President for the Technical Division serves as Chairman of the Technical Council, which in effect is the executive branch of the Technical Division.

The purpose of the Technical Council is to originate, stimulate and otherwise develop technical activity within the Institute; to coordinate the work of various technical committees of the organization, and to correlate these activities with the work of similar committees of other organizations; to pass on technical reports developed by technical committees or reports otherwise developed which may bear the name of the Institute; and to recommend to the Board of Direction for approval all papers or reports which might constitute Institute policies, standards or recommendations.

Membership

In addition to the Vice President who serves as Chairman, the Technical Council normally has nine members and a secretary. Two of the members are ex-officio—the President and the Executive Secretary of the Institute. The other seven members are designated as heads of the seven technical Departments into which all committees are grouped. All the Department Heads are named by the Board of Direction, acting on the recommendation of the Council, and they, plus the ex-officio members, form the voting membership of the Council.

From time to time, other individuals (members or non-members of the Institute) may be appointed to the Technical Council by the President. Such selections are made on the basis of contributions which these individuals can make by virtue of their duties or

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connections. Currently serving on the Council in this manner are the Editor of the *Traffic Engineering Handbook*, the Chairman of the Department of Traffic and Operations of the Highway Research Board, and the Engineer of Traffic and Operations of the Highway Research Board. Such Presidential appointments are non-voting memberships on the Council.

In all cases, members of the Technical Council act as individuals and not as representatives of their employers or other agencies.

Duties

The By-Laws of the Institute provide that the Board of Direction "shall establish a Technical Council to correlate technical committee activities of the Institute." They also state that the Council shall operate under rules of procedure approved by the Board.

Operating on this authority, the Council holds meetings, establishes committees, suggests activities to committees and to others, and reviews reports produced through its efforts. Reports containing policies, standards or recommendations in the name of the Institute are forwarded to the Board of Direction with a recommendation from the Council. Others may be published by the Council.

Meetings

The Technical Council normally meets three times during the year. One meeting is held at the time of the Annual Meeting, another is held in January at the time of the Highway Research Board meeting, and a third meeting is held in the spring, usually in May.

The schedule of work for the Council is as follows:

Fall Meeting—

a. Approve lists of committee members for the coming year;

b. Appoint the Chairman of the Technical Sessions Committe for the following year;

c. Review progress reports of committees appointed the year before.

Winter Meeting—

a. Act on completed Committee reports from the previous year;

b. Review progress reports of new Committees;

c. Formulate the technical program for the next Annual Meeting;

d. Nominate new members of the Technical Council.

Spring Meeting—

a. Review progress reports of committees.

b. Complete the program for the next Annual Meeting;

c. Select Committee titles and project scopes for the coming year;

d. Give preliminary consideration to membership of these Committees.

Normally action by the Technical Council is on the basis of a majority vote of those present. In the event the vote is on the approval of a Committee report, however, an affirmative vote by two-thirds of the voting membership of the Council is required.

Technical Departments

To function most efficiently the work of the Technical Council is divided into Departments, each of which is under the supervision of a Department Head. These Department Heads, mentioned above, are the basic voting members of the Technical Council.

Currently there are seven Departments, as follows:

Dept. 1—Joint Committees and Representatives to Other Organizations

Dept. 2—Professional Standards, Educations and Administration

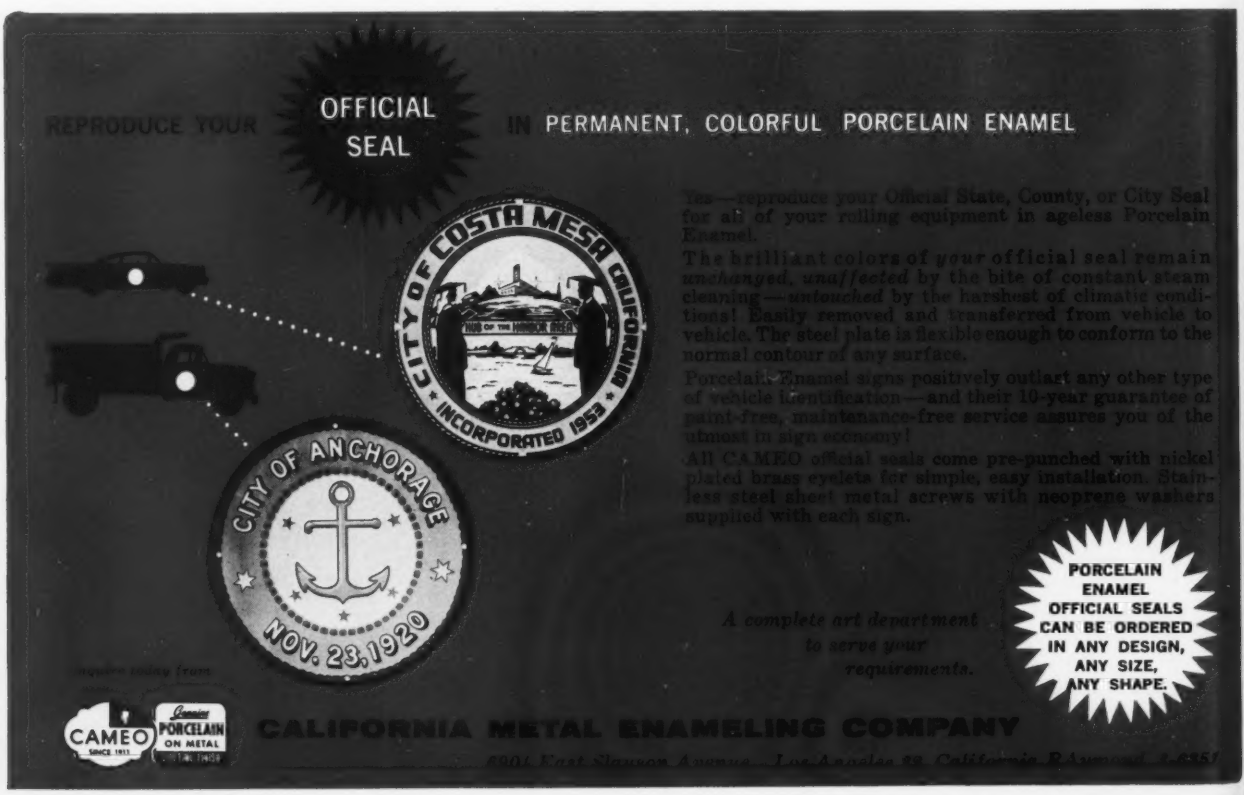
Dept. 3—Traffic Operations Measures

Dept. 4—Applications of Traffic Control Devices.

Dept. 5—Geometric Design of Traffic and Terminal Facilities

Dept. 6—Transportation Planning

(Continued on page 61)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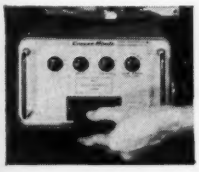

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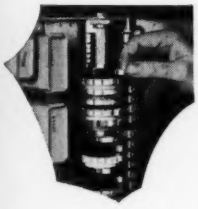

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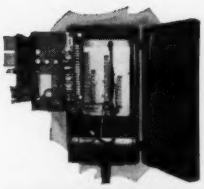

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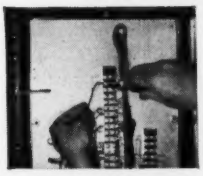

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CABRERA, Isaac T. (Associate)
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CONLEY, Richard A. (Member)
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FLANAKIN, H. A. Mike (Member)
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Traffic Engineer, De Leuw, Cather & Co., 150 N. Wacker Drive, Chicago, Illinois. FInancial 6-0424. SEND MAIL: 5246 Glenwood Avenue, Chicago 40, Illinois.

MARSTON, William R. (Member)
Ass't. Commissioner, Dept. Streets & Sanitation, City, Room 707 City Hall, Chicago, Illinois. RAndolph 6-8000. SEND MAIL: 860 Lake Shore Drive, Chicago 11, Illinois.

MAY, John F. (Junior)
Assistant Traffic Engineer, Illinois Division of Highways, 801 State Office Building, Springfield, Illinois. LAkeside 7-6611, ext. 5074. SEND MAIL: 1028 South Second Street, Springfield, Illinois.

McCANDLISS, Alfred N. (Member)
Safety Director, U. S. Army, Port Area Command, A. P. O. 21, New York, New York. Telephone: La Rochelle Military 305.

McREYNOLDS, Marshall B. (Associate)
President, Traffic Engineers Supply Corp., 5204 Lakeside Avenue, Richmond 28, Virginia. ELgin 8-4847.

NOLAN, Robert J. (Associate)
Senior Highway Engineer, Bureau of Planning & Traffic, New Jersey State Highway Dept., 1035 Parkway Avenue, Trenton, New Jersey. TUxedo 2-3000, ext. 251. SEND MAIL: Rocktown Road RD #1, Lambertville, New Jersey.

O'CONNOR, David J. (Associate)
Engineer III, Wisconsin Highway Commission, State Office Building, Madison, Wisconsin. ALpine 6-4411.

REEN, Calvin G. (Associate)
Professor of Civil Engineering, Pennsylvania State University, University Park, Pennsylvania. UNiversity 5-2852. SEND MAIL: 414 Kemmerer Road, State College, Pennsylvania.

SCHEXNAYDER, Gerard E., Sr. (Junior)
185 Willow Drive, Gretna, Louisiana.

SCHROEDER, Walter R. (Associate)
Traffic Engineer, City, P. O. Box 2023, Stockton, California. HOward 5-5751, ext. 260.

SCHWAR, Johannes F. (Associate)
Transportation Center, 1810 Hinman Avenue, Evanston, Illinois. UNiversity 9-1800, ext. 268.

SCOTT, Walter S. (Junior)
Traffic Engineer, Community Planning Consultants, 1553 Robson Street, Vancouver 5, B. C., Canada. MUtual 3-8491. SEND MAIL: 2711 West 23rd Avenue, Vancouver 8, B. C., Canada.

SHEBESTA, Harvey (Associate)
District Traffic Engineer, State Highway Commission, 794 N. Jefferson Street, Milwaukee 2, Wisconsin. BRoadway 1-6934. SEND MAIL: 2345 Mayfair Drive, Brookfield, Wisconsin.

STREB, Paul L. (Associate)
Traffic Engineer, The Port of New York Authority, 111 Eighth Avenue, New York 11, New York. ALgonquin 5-1000.

VANDERSTEMPEL, Theodore M. (Member)
Director of Parking & Traffic Engineering, City of Ann Arbor, City Hall, Ann Arbor, Michigan. NOrmandy 2-6583.

WOHL, Martin (Junior)
Assistant Professor of Transportation Engineering, Room 1-131, Civil Engineering Dept., Massachusetts Institute of Technology, Cambridge 39, Mass. University 4-6900, ext. 2728.

WONG, Oliver D. K. (Associate)
Traffic Engineer, Division of Highways, Department of Transportation, 869 Punchbowl Street, Honolulu 13, Hawaii. 5-0511, ext. 366. SEND MAIL: 3019 Gulston Street, Honolulu 16, Hawaii.

Membership Applications

The Institute of Traffic Engineers welcomes applications from qualified traffic engineers, but does not desire as members persons who are unqualified. Listed below are the names of those from whom applications for membership or transfer in grade have been received since the last published list. Institute members are urged to review this as soon as possible and immediately inform the Executive Secretary's office if names of people are found who are known to be unqualified for ITE membership or transfer.

New Applications

BERRY, Maurice
Traffic Engineer II—Pennsylvania Department of Highways, Traffic Engineering Bureau, 21st and Herr Streets, Harrisburg, Pennsylvania—for ASSOCIATE.

CHANEY, Richard W.
District Traffic Engineer (Sr. Highway Engineer)—California Division of Highways, District XI, 4075 Taylor Street, San Diego, California—for MEMBER.

DEATON, Willis Robert
Assistant Traffic Engineer—City; Room 205 City Hall, 600 East Trade Street, Charlotte, North Carolina—for JUNIOR.

GREEN, Harry Horton
Supervisor Traffic Engineering, Signal Division—City, 1801 A Street, S.W., Cedar Rapids, Iowa—for ASSOCIATE.

HARPER, Brian Charles Seymour
Planner Denver Metropolitan Area Transportation Study—City and County of Denver, Planning Office, City-County Building, Denver, Colorado—for JUNIOR.

HAWKSLEY, Robert Albert
Chief Planning & Traffic Engineer—Howard, Needles, Tammen & Bergendoff, 99 Church Street, New York 7, New York—for MEMBER.

LICHTMAN, Albert Pincus
Traffic Engineer—Cape Town City Council, City Hall, Cape Town, South Africa—for ASSOCIATE.

LOBENBERG, Jacques
Assistant District Traffic Engineer, District X—State of California, 1976 E. Charter Way, Stockton, California—for ASSOCIATE.

MENDELSON, David
Traffic Engineer—Edwards and Kelcey Consulting Engineers, 3 William Street, Newark 2, New Jersey—for JUNIOR.

PRYER, James Albert
Engineer, Grade 3, Department of Public Works—City, 129 Adelaide Street, Toronto, Ontario, Canada—for JUNIOR.

RODEN, Norman Carl
Traffic Engineer—City, Room 327 City Hall, St. Louis, Missouri—for JUNIOR.

ROER, Paul O.
Traffic Engineer—Ontario Department of Transport, Parliament Buildings, Queens Park, Toronto, Ontario, Canada—for JUNIOR.

TUC, Le-canh
Engineer—Planning & Research Division, Highway Department, Saigon, Viet-Nam—for JUNIOR.

WILSON, James Edwin
District Traffic Engineer, District X—Department of Public Works, California Division of Highways, P. O. Box 2048, Stockton, California—for ASSOCIATE.

WYATT, Arthur Gordon
Traffic Engineer—City Hall, Eugene, Oregon—for ASSOCIATE.

ZEVALLOS, Enrique
Assistant Chief Engineer—Highway Executive Committee of Guayas, Velez #109, Box 4182, Guayaquil, Equador—for ASSOCIATE.

Applications for Transfer

ANGELL, James E.
City Traffic Engineer—City Hall, Santa Monica, California—for ASSOCIATE.

BOESEL, John L.
Traffic Technician—Idaho Dept. of Highways, 155 South 8th Street, Boise, Idaho—for ASSOCIATE.

BRADFORD, Lewis P.
Traffic Engineer—City Hall, Jackson, Mississippi—for MEMBER.

CASSERA, Vincent I.
Traffic Engineer & Director of City Planning—76 Bayard Street (City Hall), New Brunswick, New Jersey—for ASSOCIATE.

(Continued on page 62)

TECHNICAL COUNCIL

(Continued from page 58)

Dept. 7—Design and Standards for Devices, Equipment and Materials

Each Department, in addition to the Head, may have a Standing Committee and up to three active project committees. An Assistant Department Head may also be named.

Department 1 is somewhat different, in that there are no project committees. The Department is made up of the officially appointed ITE representatives to national joint committees and to other organizations. For instance, the seven-man delegation to the National Joint Committee on Uniform Traffic Control Devices falls within Department 1, as do the ITE representatives to the American Standards Association and the National Safety Council. Currently there are eleven such groups with ITE representation from this Department.

The Department Head, his assistant, and his Standing Committee administer the affairs of the Department. The Standing Committee is in effect an advisory group, assisting the Head in determining research needs in the field of the Department and reviewing Committee reports before submission to the Technical Council. The Department Head is the executive of the Department. He appoints the Standing Committee, calls meetings of the Department, suggests activities for project committees, selects personnel for these committees, and in general assumes responsibility for the functioning and accomplishments of the Department. As already pointed out, the Department Head serves as a voting member of the Technical Council.

Project Committees

The Project Committees are the working staff of the Technical Division. It is through their study and research that the Institute is able to produce useful reports and other materials that form the storehouse of technical knowledge that makes traffic engineering a profession.

Projects for technical committees are approved by the Technical Council at the Spring meeting. Between then and the Annual Meeting, the Department Head and his Standing Committee select committee members. The newly formed committee meets at the time of the Annual Meeting and outlines its activities, working toward the submission of a report at the following Annual Meeting. After the report is submitted, the Standing Committee and the Department Head review it and pass it on to the Technical Council. If the Council approves, it is ready for publication or for further submission to the Board of Direction. The Board is required to review all reports which constitute Institute policy, standards or recommendations.

Membership on technical committees is determined by the Department Head, working in conjunction with the chairman of the committee. Institute members interested in serving on a committee, therefore, should communicate with the proper Department Head. These were listed in the September issue of *Traffic Engineering*— or members can write to the Secretary of the Technical Council, Mr. Stephen G. Peterson, at headquarters.

Special Committees

In addition to the Technical Departments and their project committees, the Technical Council regularly includes certain other committees. Each year, for instance, the Council itself serves as the Committee on Technical Sessions, planning the technical program of the Annual Meeting.

Other committees responsible to the Technical Council at the present time include the Traffic Engineering Handbook Editorial Board, charged with the supervision of the editorial content of the new edition of the Handbook; the Revision Committee of the Manual on Traffic Engineering Studies, charged with revising the Manual (publication rights having been transferred to the Institute by the former publisher, the Association of Casualty and Surety Companies); and the Review Committee of the Technical Development and Research Fund. The latter committee, composed of five persons of whom three are named by the Institute and two are nominated by the contributors to the Fund, will provide the initial review of all projects for which use of the monies in the Fund is proposed.

Procedures

Procedures of the Technical Council have been formalized in several documents, including "Rules of Procedure of the Technical Council," "Administrative Details of Council Procedure," and "Instructions on Preparation of Technical Committee Reports." Copies are available upon request.

Section News

WESTERN SECTION

The 13th Annual Meeting of the Western Section, Institute of Traffic Engineers, was held at the Jack Tar Hotel in San Francisco, July 17-20. Approximately 170 men and 70 ladies registered at the meeting. The five technical sessions were very well attended and the various papers presented were received appreciatively. The authors should be complimented on the excellence of their presentations, and Bob Glenn and his committee for organizing this superb program. Most of the papers will appear in the Proceedings to be published within the next few months. Section business was conducted at the two business meetings. In addition, delegates had plenty of opportunity to eat, drink, and make merry.

FLORIDA SECTION

Traffic Engineering Short Course
Oct. 3-5, Gainesville, Florida

Judging by the volume of inquiries and amount of interest being shown by people throughout the state and in other parts of the country, the First Annual Traffic Engineering Short Course being sponsored by the Florida Section promises to be well-attended and successful. All speakers have been confirmed, and the final details and arrangements are nearly complete. All lectures will be given in the Student Service Center on the University of Florida Campus.

On August 26th, the City of Miami and Metropolitan Dade County received I.T.E. awards for traffic engineering performance during 1959. Dade County was the only county in the nation and Miami the only city in Florida to receive awards. The awards were presented for I.T.E. by our Section President, Ed Mueller.

Ground was broken for the Lincoln Road Shopping Mall, Miami Beach, on July 11, 1960. Metropolitan Dade County Traffic and Transportation Department, in cooperation with Miami Beach officials, have conducted volume, capacity and parking studies. Principal traffic engineering problems included signal timing changes, bus rerouting, bus stop relocation, pedestrian walk-wait signals, and lane reallocation. Thanksgiving is the target date for completion of the $550,000 traffic-

free shopping promenade, which will run from Washington Avenue to Alton Road.

Three technical papers were submitted from the Section for possible presentation at the Annual Meeting in Chicago. The one selected is a paper co-authored by Ed Mueller and Jack Barr entitled, "Traffic Diversion Effects of an Interstate Highway Spur" (Route 195 to Miami Beach).

A pilot course for Traffic Signal Electricians is scheduled for next January in Pinellas County. This short course program is being developed jointly by the Florida Section of I.T.E. and the Florida Association of Traffic Signal and Street Lighting Employees, and it is hoped that it will be presented annually. At their meeting on August 26th, your Board of Directors voted to support this program. On the committee are: Ed Mueller, representing the Florida Section; Aubrey Ort, representing the Traffic Signal Employees Association; Bob Freeman, representing S.R.D. and an educator from Pinellas County.

CANADIAN SECTION

1960-1961 Officers

(Elected Sept. 14, 1960)

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By Joseph Tremblay

MEMBERSHIP APPLICATIONS

(Continued from page 60)

COLPITTS, Robert Joseph
Traffic Engineer—City Hall, 201 West Main Street, Alhambra, California—for ASSOCIATE.

CROWLEY, Kenneth William
Research Analyst——Port of New York Authority, 111 Eighth Avenue, New York 11, New York—for ASSOCIATE.

DIERSTEIN, Philip G.
Traffic Maintenance Supervisor—Illinois State Toll Highway Commission, Twenty-second and Midwest Road, Hinsdale, Illinois—for ASSOCIATE.

HOCHSTEIN, Samuel
Director of Traffic Services—New York City Department of Traffic, 100 Gold Street, New York, N. Y.—for ASSOCIATE.

HOLLOWAY, Frank M.
Assistant Engineer of Traffic (Civil Engineer III)—Florida State Road Department, Tallahassee, Florida—for ASSOCIATE.

HUBBARD, Robert Albert
Associate Traffic Engineer—Virginia Department of Highways, 1221 E. Broad Street, Richmond 19, Virginia—for ASSOCIATE.

MAYER, Howard Charles
Outdoor Lighting Specialist—General Electric Co., 570 Lexington Avenue, New York 22, New York—for ASSOCIATE.

MILLER, Clifford Harold
Traffic Engineer—Room 411 City Hall, Tulsa, Okla.—for MEMBER.

MUELLER, Edward A.
Assistant Engineer of Traffic & Planning—State Road Dept. of Florida, Tallahassee, Florida—for MEMBER.

ROTMAN, Morris
Traffic Analysis Engineer—City, Dept. of Public Works, Traffic Division, 129 Adelaide Street, West, Toronto, Ontario, Canada—for ASSOCIATE.

Positions Available

FRESNO COUNTY, CALIFORNIA

Position: Assistant Traffic Engineer.

Salary: $563-$703.

Requirements: Engineering College graduate plus one year's graduate work in traffic or transportation plus one year of TE experience. An additional year of experience may be substituted for the required graduate work.

Apply: E. W. Firby, Director of Personnel, Room 101 Hall of Records, Annex, Fresno 21, California.

(Continued on page 64)

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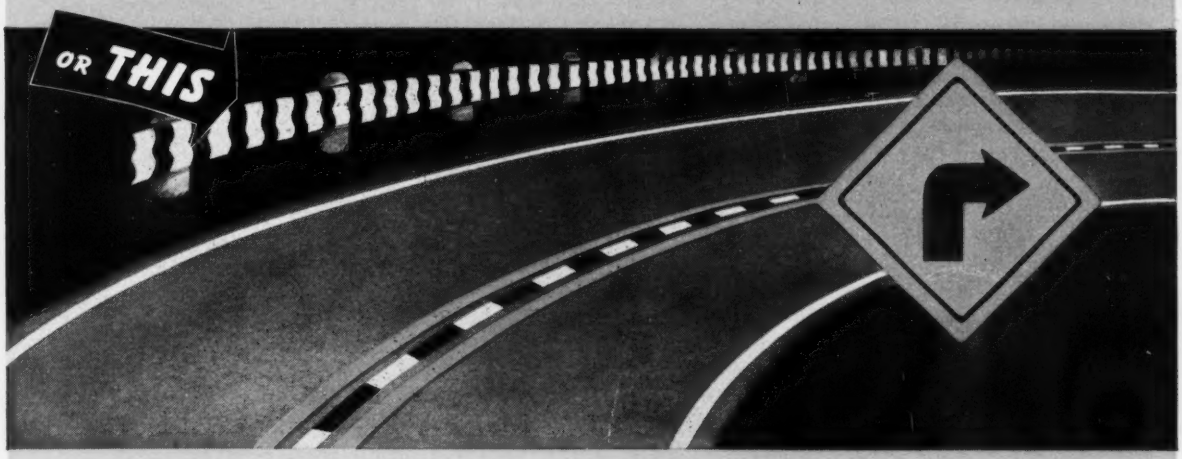

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CITY OF SAN DIEGO, CALIFORNIA

Position: Associate Traffic Engineer.

Salary: $713-$866 per month.

Requirements: Equivalent to graduation from college with major work in engineering, plus three years of professional experience.

Apply: Room 453, Civic Center, 1600 Pacific Highway, San Diego, Calif., before November 21 at 4:30 p.m.

Position: Senior Traffic Planner.

Salary: $825-$1002 per month.

Requirements: Equivalent to graduation from college with major work in civil engineering, urban planning or related field, plus four years of progressively responsible transportation planning experience. Up to two years of highway design experience may be substituted for planning experience.

Apply: Room 453, Civic Center, 1600 Pacific Highway, San Diego, Calif., before November 14 at 4:30 p.m.

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